CHEVROLET
Repair Manual

for Economical Transportation

Issued by

CHEVROLET MOTOR COMPANY

DIVISION OF GENERAL MOTORS CORPORATION

GENERAL MOTORS BUILDING

DETROIT, MICHIGAN

CHEVROLET
Repair Manual

Showing Short Cuts and Methods
for Repairing
Chevrolet Motor Cars

for Economical Transportation

CHEVROLET

CHEVROLET MOTOR COMPANY
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Standard Warranty

Approved as to Form by National Automobile Chamber of Commerce, Inc.

We warrant each new motor vehicle manufactured by us to be free from defects in material and workmanship under normal use and service, our obligation under this warranty being limited to making good at our factory any part or parts thereof which shall within ninety (90) days after delivery of such vehicle to the original purchaser be returned to us with transportation charges prepaid, and which our examination shall disclose to our satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on our part, and we neither assume nor authorize any other person to assume for us any other liability in connection with the sale of our vehicles.

We do not make any guarantee against, and we assume no responsibility for, any defect in metal or other material that cannot be discovered by ordinary factory inspection, or in any part, device or trade accessory.

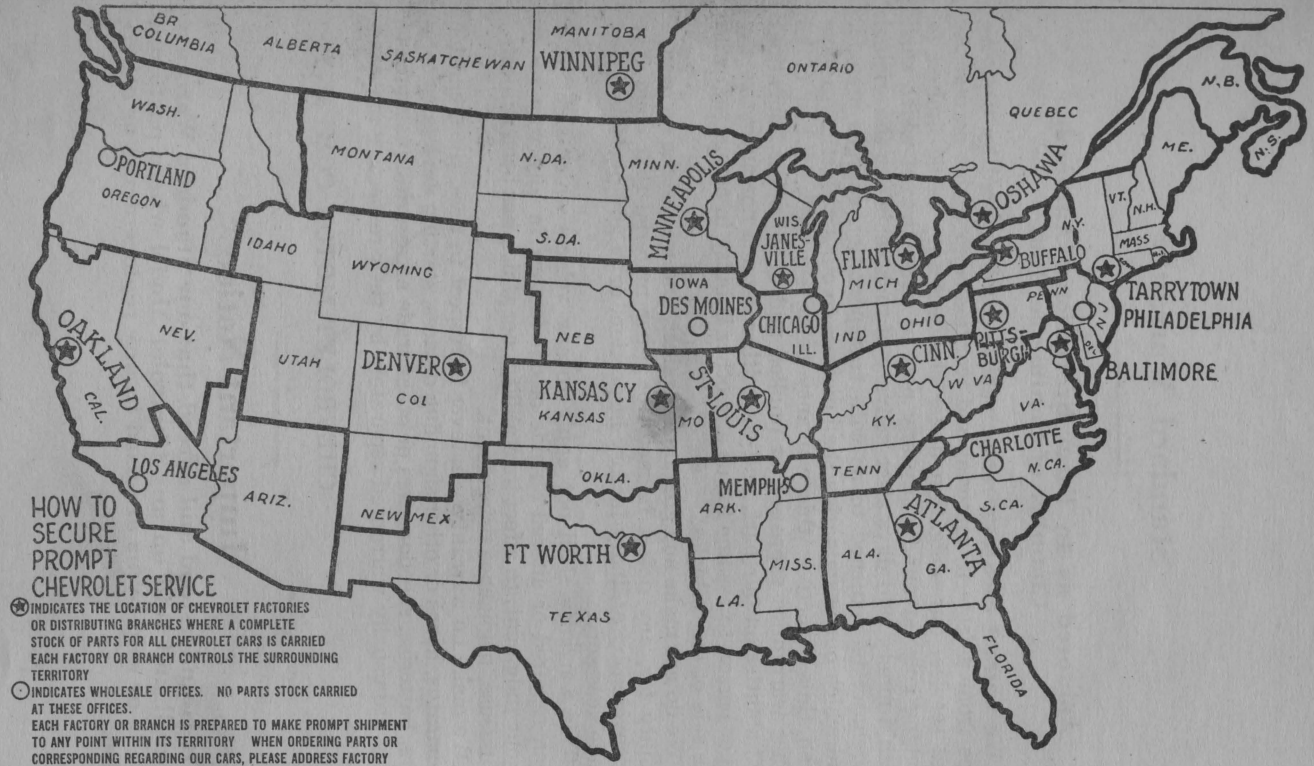
This warranty shall not apply to any vehicle which shall have been repaired or altered outside of our factory in any way so as, in our judgment, to affect its stability, nor which has been subjected to misuse, negligence or accident.

We make no warranty whatever in respect to tires, rims, ignition apparatus, horns or other signaling devices, starting devices, generators, batteries, speedometers or other trade accessories, inasmuch as they are usually warranted separately by their respective manufacturers.

CHEVROLET MOTOR COMPANY.

Important Notice

It is understood and agreed that our Standard Warranty is null and void on any Chevrolet Model where parts not made or sold by us are used in any replacements or otherwise.



HOW TO SECURE PROMPT CHEVROLET SERVICE

★ INDICATES THE LOCATION OF CHEVROLET FACTORIES OR DISTRIBUTING BRANCHES WHERE A COMPLETE STOCK OF PARTS FOR ALL CHEVROLET CARS IS CARRIED EACH FACTORY OR BRANCH CONTROLS THE SURROUNDING TERRITORY

○ INDICATES WHOLESALE OFFICES. NO PARTS STOCK CARRIED AT THESE OFFICES.

EACH FACTORY OR BRANCH IS PREPARED TO MAKE PROMPT SHIPMENT TO ANY POINT WITHIN ITS TERRITORY WHEN ORDERING PARTS OR CORRESPONDING REGARDING OUR CARS, PLEASE ADDRESS FACTORY OR BRANCH CONTROLLING TERRITORY IN WHICH YOU RESIDE.

Preface

For a mechanic to perform carefully and intelligently the duties required in a Service Station, it is necessary that he understand the construction and the various functions which component parts perform, in order to deliver to the owner the satisfactory "service" to which he is entitled.

With a thorough understanding of the working parts, and their relation one to the other, this service can be delivered without the least hesitation.

We have attempted in this Repair Manual to deliver a clear and concise message, which will enable any mechanic to make the necessary repairs and adjustments on Chevrolet cars.

In trying to diagnose the various ailments common to an automobile, we have illustrated different parts of the car and have described the easiest and simplest methods to be used when it becomes necessary to make repairs, adjustments or tests. The various operations performed in disassembling or assembling a car are graphically illustrated, which we trust will deliver a clearer message than is possible to obtain in a word picture.

It has been made simple, with technical terms eliminated, for the benefit of the mechanics who have had previous experience.

The simplicity and accessibility of Chevrolet cars make it possible for one with previous mechanical experience to secure satisfactory results.

We have provided service facilities in every part of the world.

At our Distributing Branches and Factories we maintain a service organization, which is at your disposal at all times, and which will be glad to give you any information you may desire.

CHEVROLET MOTOR COMPANY

Directions for Ordering Parts

Refer to page 4, showing zone map of the United States and Canada.

The **stars** indicate the location of Chevrolet factories or distributing branches where a complete stock of parts for all Chevrolet cars is carried. Each factory or branch controls the surrounding territory. **The circles indicate wholesale zone only. A parts stock is not carried at these points.**

When ordering parts be sure to give the model, year produced, and car number for which parts are desired.

The model and car number will be found on the name plate attached to the dash under the instrument board, or left front seat frame.

If in doubt as to the name of the part needed, send the broken part to your dealer, or the factory, by prepaid express. Write your name and address plainly on the package so that it can be identified upon arrival. Write a letter the same day shipment goes forward, stating the purpose for which it is returned, regardless of any previous correspondence.

In ordering from the factory, if possible always send cash with your order, because we cannot open accounts except with our regularly appointed dealers. Orders not accompanied by cash, certified check or money order, will be sent C. O. D.

In ordering parts by telegram, be sure the message is prepaid. Collect messages will not be accepted by this company. Always confirm the telegram by a regular order, marked "confirmation of telegram," through mail.

All Chevrolet dealers carry a stock of such parts as are needed most frequently; therefore, delays can be avoided by ordering from your nearest dealer.

The following is a list of manufacturers supplying accessories for Chevrolet Cars, and as under the terms of our warranty these are guaranteed separately by the manufacturers, any questions as to the repair or replacement of the units may be taken up with them or their nearest service station.

Battery:—
Willard Storage Battery Co., Cleveland, Ohio, or authorized service stations.
Electric Storage Battery Co., Philadelphia, Pa., or authorized Exide Service Stations.

Carburetor:—
Zenith Carburetor Co., Detroit, Mich.; Holley Carburetor Co., Detroit, Mich., or authorized service stations.

Circuit Breaker:—
Electric Auto-Lite Co., Toledo, Ohio, or authorized service stations.

Coil:—
Remy Electric Co., Anderson, Ind., or any branch of United Motors Service, Inc.

Generator:—
Remy Electric Co., Anderson, Ind., or any branch of United Motors Service, Inc.
Electric Auto-Lite Co., Toledo, Ohio, or authorized service stations.

Distributor:—
Remy Electric Co., Anderson, Ind., or any branch of United Motors Service, Inc.

Rims:—
Any branch of United Motors Service, Inc.

Starting Motor and Starting Switch:—
Electric Auto-Lite Co., Toledo, Ohio, or authorized service stations.
Remy Electric Co., Anderson, Ind., or any branch of United Motors Service, Inc.

Speedometer:—
Stewart-Warner Corporation, Chicago, Ill., or authorized service stations.

Tires:—
Goodyear Tire & Rubber Co., Akron Ohio
Goodrich Rubber Co., Akron, Ohio.

Chapter I

A Detailed Description of the Things Most Likely to Cause Difficulty and How to Diagnose Them

How the Motor Operates

The Chevrolet motor is the overhead poppet valve type. All models have four cylinders on which the firing sequence is 1-2-4-3.

All Chevrolet Motors are "Four Cycle," which means there are four complete strokes of the piston or two complete revolutions of the fly wheel to complete one firing sequence.

1. As the piston starts downward in the first stroke of the cycle the intake valve is opened. The motion of the piston creates a vacuum in the cylinder and draws a charge of gas from the carburetor through the valve opening.

2. When the piston reaches the bottom of its stroke and starts upward on the second stroke of the cycle, the intake valve closes and the piston compresses the gas that is drawn in to the space at the top of the cylinder.

3. As the piston reaches the end of its upward stroke the compressed gas is ignited by an electric spark which occurs at the points of the spark plug and the resulting explosion or expansion pushes the piston downward, turning the crank shaft on the third cycle or working stroke.

4. On the upward stroke of the piston, the exhaust valve is opened and the piston forces the remaining burned gas out through the exhaust pipe leaving the cylinder empty and ready for the beginning of a new cycle.

Motor Fails to Start

If for any reason the motor does not start immediately under its own power, remove your foot from the starting button at once. One of the following things may be causing the trouble:

Ignition switch may not be turned on.

The storage battery may be partially discharged and when the starting motor is in operation, not enough electric current is flowing to the coil to produce a spark sufficient to ignite the gas. (See Pages 138-141.)

The coil may be burned out. (See Page 149.)

The contact points in the distributor may not be opening or the points may be burned so badly as to remain open. (See Page 147).

The primary wire from coil to distributor, coil to switch or to battery, may be loose or broken, making poor contact.

Spark plug points fouled with oil or carbon.

Secondary wire from coil to distributor cover disconnected at coil.

Gasoline supply exhausted.

Filter screen in carburetor or vacuum tank may be clogged with sediment so gasoline cannot enter float chamber. (See instructions Page 120 on carburetors and page 126 on vacuum tanks regarding the cleaning of this screen.)

Gasoline line may be clogged with dirt or if it is cold weather an accummulation of water in the line may have frozen.

The carburetor choke rod may not be pulled out far enough, providing the motor is cold, to make the mixture rich enough to ignite, or the choke valve may have been closed too tight, causing the mixture to be so rich with gasoline that it will not ignite.

Water in Gasoline System

If there is water in the gasoline it will not mix, but, being heavier than gasoline, will find its way to the bottom or lowest point in the system, which is at the carburetor. In cold weather it may freeze. By pouring hot water or applying hot cloths to the supply pipe and carburetor this can be loosened up. If poured on, be careful that none enters the carburetor.

Motor Misses at High Speed Only

There is insufficient gasoline flowing to carburetor due to obstruction in gasoline line or filter screen.

A valve may be sticking slightly and does not come to its seat properly.

There may be a loose electrical connection.

The spark plug points do not have the proper gap. The points should be separated about $\frac{1}{32}$ of an inch.

Motor Misses at All Speeds

Porcelain in the spark plug may be broken, allowing the spark to jump from the electrode in the center of the porcelain to the shell of the plug before entering the combustion chamber.

One or more spark plugs may be fouled. Thoroughly clean the sparking points and porcelain with cloth dipped in gasoline.

A valve may be sticking. Remove and thoroughly polish the stem.

Compression may be poor due to pitted or warped valves. (See Page 28.)

A valve spring may be broken.

Push rods may be adjusted too tight. (See Page 33.)

Adjustment for the push rods may have become loosened and valve is not opening. (See Page 33.)

Filter screen in carburetor clogged and gasoline not flowing to carburetor properly. (See Page 120.)

One of the ignition wires may be loose and due to vibration makes and breaks the contact.

Contact points in distributor are not opening and closing properly. (See Page 147.)

Contact points in distributor may need cleaning or filing. (See Page 147.)

The spark plug gaps are not adjusted properly. The gaps should be about $\frac{1}{32}$ of an inch.

The carburetor may be flooding, causing the mixture to be too rich. This is usually caused by the needle valve not seating properly.

Motor Misses at Low Speed Only

Compression is weak due to leaky piston rings or valves not seating.

There may be a leaky gasket where the carburetor is attached to the intake manifold or where the manifold attaches to the cylinder head, permitting air to enter, weakening the mixture. To detect the leak, take a squirt can filled with gasoline and squirt around where the connections are made. If any gasoline enters the opening, the speed of the motor will immediately increase thereby indicating a leak. (See Pages 30-31.)

The regulator screw which regulates the flow of gasoline at low speed only, may not be adjusted properly. Set the throttle for low speed running and turn the screw in and out to obtain the best low speed running adjustment.

The spark lever may be advanced too far. When running at low motor speeds the spark lever should be retarded.

When running at low motor speed the generator does not deliver electric current to the storage battery as the circuit breaker makes an "open" circuit in the line and ignition current is then supplied from the storage battery. If the battery is in a badly discharged condition it ofttimes happens that insufficient current is being supplied for ignition purposes.

There may be one or more weak exhaust springs and with the throttle practically closed the vacuum created in the cylinders by the piston on the suction stroke will open the exhaust valve, drawing in burned gases and weakening the mixture so it will not burn. (See Fig. 8.)

Motor Stops Suddenly

If the motor stops suddenly without any further explosions:

Examine gasoline supply.

Examine carburetor to see if gasoline is running into the float chamber.

If motor has been running along evenly and begins to miss with considerable backfiring through the carburetor and finally stops, it is usually an indication that the gasoline supply is exhausted. When the gasoline gets below a certain point in the carburetor, an insufficient supply is furnished to the cylinders which produces a slow-burning mixture with the resultant backfiring.

Examine the switch, and, at any point on the reverse side of the instrument board where wires are attached, at the storage battery, distributor and on the coil, for loose connections, as a wire might have become detached.

The switch may be burned out, or the key does not produce a contact.

Test the coil (See Page 149) to determine whether it is burned out, and, in fact, make a thorough examination of the entire ignition system.

Test the wires at the distributor (See Page 147) to determine whether electricity is getting through the ignition switch.

If it is found that the electrical connections are all tight and that there is electricity in the wires, examine the distributor, as the cam which operates the breaker arm may have become loosened and the contact points are not opening. If this is found to be the case see Page 144 for retiming distributor on Model 490, Superior & G. (Page 143 on Models FA., FB, T.)

Motor Spits and Backfires

This is usually an indication of carburetion faults although the backfiring through the exhaust pipe or muffler may be due to defective ignition. If for any reason the distributor or ignition apparatus fails to operate for a few revolutions of the motor, there is a considerable amount of unburned gas forced from the cylinders into the exhaust pipe and muffler, then when the gas is ignited in the cylinders the flame which is emitted through the exhaust valve ignites the gas in the muffler causing an explosion.

Backfiring and spitting through the carburetor is often due to a weakened mixture, which is slow-burning, and as there is still a certain amount of flame in the cylinder when the intake valve opens to receive the new charge of gas, the result is that the gas in the intake pipe is ignited. The cause is usually a low gasoline supply or a clogged gasoline system, or there may be small air leaks in the in-

take manifold or at the connections which allows air to enter, making the mixture too lean.

Carbon deposits on top of the piston or on the sides of the combustion chamber becoming heated to a degree of incandescence will sometimes ignite the incoming charge of gas, causing a backfire through the carburetor.

One of the intake valves may be sticking and not getting to its seat in time. It should be removed and the stem polished. (See Page 29.)

Starting Motor Does Not Operate

This is not an infrequent source of difficulty and may be caused by any one of the following:

Exhausted storage battery due to excessive use of the starting motor or lights and is the direct result of failure on the part of the owner in not observing the rules set forth for the care of his battery. (See Page 140.)

Broken or loose wires either at the battery, starting switch or starting motor. Examine all connections and wires carefully.

Starter cables may be loose at the battery posts or have become corroded and are not making a good contact. Remove and thoroughly clean, then cover with vaseline or petroleum jelly.

The cable leading from the negative post of the battery to the ground terminal on the starting motor may be loose at the terminal post.

Starting switch making poor contact. Remove the switch and make necessary repairs or adjustments.

Starting motor may be "short-circuited" or may have shifted out of line. (See Pages 136-138.)

Motor Overheats

The following causes will usually lead to a hot motor:

Low water supply in the radiator. It is just as necessary to have a full tank of water as it is to have plenty of gasoline or oil. Make it a rule to regularly inspect and fill the radiator.

Radiator tubes stopped with lime deposit. The radiator should be thoroughly flushed and cleaned. (See Page 16.)

Fan belt too loose, or broken, causing fan to stop rotating. See Page 52 on adjustment and replacement.

Oil not circulating through the motor properly, or it may be diluted with gasoline to such an extent that the friction reducing qualities are affected. (See pages 56-57.)

Late or retarded spark. This is usually apparent by a marked loss in power. A late spark produces a slow-burning charge which

causes an increased amount of heat due to the piston having started downward on the power stroke, reducing the density of the compressed gas before it is ignited. See Pages 143-144 covering ignition timing.

Gasoline mixture too rich. With the type of carburetor used on Chevrolet cars, this seldom occurs, as the adjustment cannot be changed without removing the jets; however, an obstruction in the carburetor air intake, such as the choke valve becoming turned so as to obstruct the free passage of air, would increase the suction on the carburetor jets, making the mixture too rich.

Motor Lacks Power and is Sluggish

This is very apparent when ascending a slight grade or in attempting to accelerate the motor suddenly, and may be caused by the following:

Carbonized Valves

As the motive power is obtained by burning or exploding a highly compressed gas mixture, it follows that a certain amount of carbon will be deposited on the valve seats, piston head and combustion chamber. Small particles of burnt carbon will lodge under a valve, especially the exhaust, holding it open. As this exposes the valve seats to the heat generated by the explosion, small pits or burnt spots will in time cause the surface to be so roughened as to prevent the proper seating of the valves. This will cause a leakage of gases, resulting in loss of power and uneven running of the motor. When this occurs, grinding the valves is the only remedy.

To determine which valves need attention, turn the motor over slowly by hand and note whether the same degree of resistance is met with in each cylinder. The ones offering the least resistance are those whose valves leak. Grinding the valves is the only remedy. (See Page 28, Fig. 5.)

Worn or Broken Piston Rings

This is sometimes difficult to determine in advance, especially if the valves are badly carbonized and need grinding. By removing the cap from the breather tube and holding the ear to the opening you can sometimes hear the gas "blowing" by the rings. Inasmuch as the cylinder head must be removed to make replacement of rings, it is advisable to examine carefully the valves before going further. Should the rings be worn they should be replaced. (See Pages 50-51.)

Replacing the piston rings will not always overcome the "blowing by" of gases if the cylinder walls are worn out of round. An examination should be made to determine whether this condition exists as the new piston rings will only touch the high spots in the cylinder, leaving a space between the rings and the cylinder walls. In this

event, the only remedy is to ream or regrind the cylinders or replace the cylinder block.

Valve push rods set up too tight, causing the valves to hold open. With the motor hot, test the push rod clearance (Page 33) and adjust accordingly.

Late Ignition

If the piston starts downward on the power stroke before the spark crosses the gap of the spark plug, the compression is reduced and a portion of the effect of the expansion or explosion of the gases on top of the piston is lost. The ignition timing should be checked very carefully to see that the electric current is being delivered to the spark plug at the proper time. (See Page 143.)

Badly burned spark plug electrodes, which increases the resistance of the plugs, resulting in a weak spark. Replacing the plug is the only remedy.

Cooling System

The cooling system consists of a large cellular type radiator and a belt-driven centrifugal pump. As the circulating pump is connected to the lower radiator outlet the water is drawn through the radiator

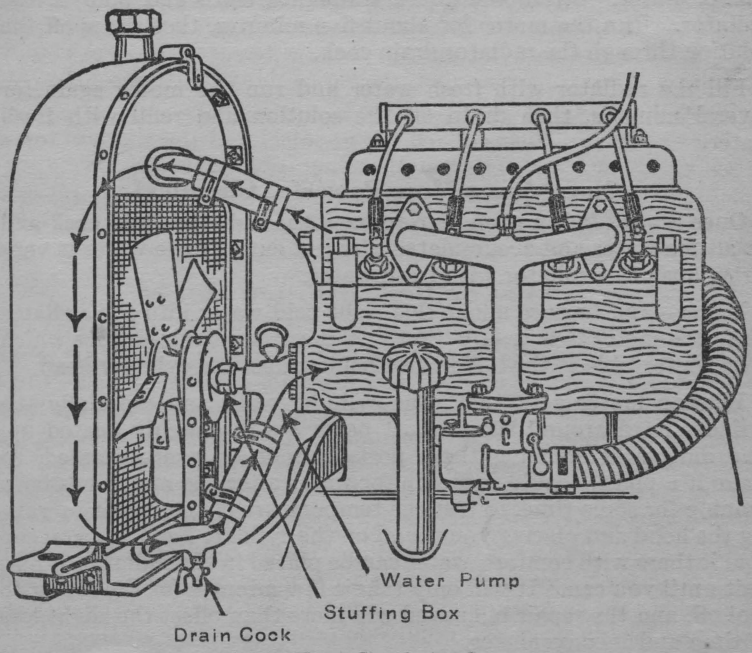


Fig. 1—Water Circulating System

before being delivered to the water jackets surrounding the cylinder walls, which insures a proper circulation of cool water at all times, regardless of engine speed (Fig. 1.)

Should water leak through the stuffing box on the end of the pump, tighten the nut. If this does not stop the leak, unscrew the stuffing box and wrap around the shaft ordinary candle wicking that has been saturated with tallow or graphite grease and tighten the nut again.

Keep the cellular openings clean. Never allow mud to remain in them as it cuts down the radiation and prevents proper cooling. The entire circulating system should be thoroughly flushed out occasionally. This can be done in ordinary cases by disconnecting both the upper and lower hose connections and allowing fresh water to enter the filler neck and flow down through the radiator and out the lower hose. The motor water jackets can be flushed out in the same way.

When hard water has been used, a scale or deposit will be formed which, unless removed, will obstruct the circulation, causing unnecessary heating and frequent refilling. In this case a good way to clean out the scale is to dissolve a half pound of lye in about five gallons of water. Strain the liquid through a cloth and pour in the radiator. Run the motor for about five minutes, then draw off the solution through the radiator drain cock.

Fill the radiator with fresh water and run the motor again for several minutes, then drain off the solution and refill with fresh water.

Never Use a More Powerful Chemical

Once a week it is a good plan to open the radiator drain cock and let all the water and accumulated dirt run out. If the water is very dirty, flush the radiator with fresh water.

Never—and be sure about this—put cold water into the radiator while the motor is hot. By "hot" we mean any temperature which is uncomfortable to the hand when held against the cylinder head.

When a motor gets "hot" the cylinder walls and especially the cylinder head around the exhaust ports are thoroughly heated up. The danger of cracking these ports cannot be overestimated, so make it a point, should you stop for water after the motor has been running for some time, to test the temperature of the motor by raising the hood and placing your hand on the cylinder head. If you can hold it there with comfort, water can be placed in the radiator; if not, wait until you can. It will only take a few minutes for the motor to cool off, and the repair bill saved will more than offset the slight loss of time and inconvenience.

Leaks in any system subject to vibration are likely to occur. It is not a good plan to put corn meal, bran or other substances in a radiator to stop a leak. It clogs up the tubes, thereby decreasing the radiating efficiency. Make a permanent repair with solder.

Winter Driving

As soon as the temperature begins to approach the freezing point, an anti-freezing solution should be placed in the radiator. Wood alcohol or denatured alcohol is best for that purpose.

The following table may be used in estimating the quantity of alcohol required for different temperatures:

Wood Alcohol		Denatured Alcohol	
10 per cent	18° F. above	10 per cent	24° F. above
20 per cent	5° F. above	20 per cent	16° F. above
30 per cent	9° F. below	30 per cent	7° F. above
40 per cent	23° F. below	40 per cent	2° F. below
50 per cent	36° F. below	50 per cent	8° F. below

Since alcohol evaporates more quickly than the water, it is well when filling the radiator to make up the loss by adding a solution of equal parts of alcohol and water.

The use of powerful chemicals, while sometimes cheaper in first cost, is very likely to cause damage later, costing more in repair bills than the amount saved, as they attack the metal system and rubber hose connections.

If the radiator should freeze, do not try to thaw it out by starting the motor, but thaw it by placing in a warm place.

It is a good plan, when making a stop in cold weather, to cover the radiator and hood with a blanket or other covering. This helps hold the heat, and in that way gives considerable protection from the liability of freezing, besides making the motor start easier.

Motor Pounds or Knocks

When a peculiar pound or knock, unusual to the regular motor sounds, is heard, it should be investigated to determine as nearly as possible its location and seriousness.

Go about the task of locating the source of trouble carefully —don't jump at conclusions, and, above all, do not operate the car until you are satisfied that no harm will result pending later repairs.

Nearly all motor noises can be definitely located. Some, however, can only be approximated. These noises are usually the result of:

An Accumulation of Carbon Deposits on Piston Heads, Valves and Combustion Chamber

A motor which is badly carbonized will pound when the power is applied suddenly or when ascending a slight grade. Retarding the

spark will reduce the noise; however, the motor will be sluggish, heat readily, and labor on the slightest pull.

Carbon will despoit in the combustion chamber of any internal combustion engine, so do not be alarmed. However, at the first opportunity the cylinder head should be taken off (Fig. 2), the carbon removed, and the valves reground (Fig. 5).

Loose or Worn Bearings

A bearing knock or thump can be detected in two ways: First, by accelerating the motor quickly, at which time a rattling and clashing sound will be produced; and, second, by starting the car with the brakes set, which will cause the motor to pull against resistance. By holding one end of a screw driver or rod to the ear and placing the other end at different points on the motor, the particular spot where the noise is loudest can be determined (Fig. 7, Page 29).

If the sound is loudest at the top of the motor, short circuit the spark plug (Fig. 117) on that cylinder. If the noise disappears you have located the cylinder in which the trouble lies.

The next step is to determine: First, whether it is due to a worn piston pin; second, to a worn or loose piston.

Worn piston pins can not always be located by short circuiting the spark plug, but by holding open an exhaust valve thereby reducing the vacuum in the combustion chamber on the suction stroke of the piston the knock will usually disappear, indicating the cylinder in which the trouble lies.

If the motor is cold, run long enough to thoroughly heat up the pistons and cylinder walls—as a cold motor will always be noisy and is likely to deceive the inexperienced mechanic.

If the noise is produced by a loose piston, retarding the spark will lessen it however, the best test is to operate the car at a speed of ten to twelve miles per hour, either on a slight grade or by having the brakes partly set. Under these conditions a knock produced by a loose piston usually develops, and by short-circuiting the spark plugs, the cylinders containing worn or loose pistons can usually be located.

To replace pistons or piston pins, remove the cylinder head (Fig. 2) and proceed as instructed on pages 45 to 52.

If the noise appears to come from the lower part of the motor, determine whether it is in the main crankshaft bearings or connecting-rod bearings. By holding the screwdriver or rod opposite the main bearings and putting the motor on a "pull," the location can usually be determined with accuracy.

Remove the lower crankcase and tighten the bearings as instructed on pages 35 to 41.

Worn or improperly adjusted push rods and valve lifters.

This is easily detected and adjustment or replacement made as per instruction (Page 37).

Loose fly wheels bolts. This sometimes is a very difficult noise to locate as the sound is transmitted to all parts of the motor and gives the impression of loose main bearings. If tightening the bearings does not remove the noise examine the fly wheel bolts.

Worn cam shaft bearings or loose timing gear keys.

This noise can be located readily, as the sound will appear to be in the timing gear case. By slipping a knife blade between the valve stem and valve rocker arm, tension will be placed on the loose part, causing the noise to disappear. Remove the timing gear case and examine the crankshaft gear key. If this is in good condition the trouble is due to loose camshaft bearings.

Lack of Oil or Water

Insufficient oil circulating through the motor or a low supply of water will cause the motor to overheat and knock. Examine the oil pump and circulating pipes. (See Pages 56 to 57.)

Clutch

The purpose of a clutch is to provide a means of engaging and disengaging the motor from the transmission and rear axle to permit gear changes. It consists of a cone shaped disk which engages in a recess in the fly wheel. The face of the cone is covered with a leather band firmly riveted to it. To prevent grabbing, expanders are placed under the clutch leather so as to present slightly raised points of contact.

The releasing and engaging of the clutch will in time produce the following conditions:

Clutch Grabs

If the clutch takes hold too quickly causing the car to start with a jerk (when the clutch is engaged slowly) the expanders should be adjusted. (See Page 74.)

Clutch Slips

The clutch leather will in time "dry" out, resulting in "grabbing" or slipping. Rub a little neatsfoot oil on the leather to soften it. Should the clutch leather become greasy, wash off with gasoline or apply a little Fuller's earth to it. Do not use sand or other gritty substances to make a slipping clutch hold.

Clutch Pedal Strikes Floor Boards

As the clutch collar wears, the clutch pedal moves backward. Occasionally the movement becomes great enough to permit the pedal to strike the floor board. The clutch, under these circumstances, will not be fully engaged and the clutch will slip. (See Pages 68-69, Figs 59-60, for adjustment of clutch pedal.)

Clutch Leather Worn

In time the clutch leather will become worn to the point where no adjustment can be made, in which event the only remedy is to renew the leather. (See Page 74, Fig. 66.)

Alignment

Occasionally the transmission bolts on Model Four-Ninety and G loosen from vibration, allowing the transmission to shift, throwing it out of line with the clutch. This will cause the clutch hub to bind on the transmission main shaft. In this case it will be very hard to operate the clutch in either direction. (See Page 79 for placing transmission in alignment.)

Clutch Rattles and Chatters When Released

The tension on the clutch spring when released is carried on a stud, one end of which is flanged to form the ball race of a thrust bearing (Fig. 63, Page 71). On Models Four-Ninety, Superior, FA, G, this bearing is lubricated by pressure through an oil hole drilled in the end of the crank shaft. Occasionally one or more balls become worn or broken. (See Page 43 on replacement of thrust bearing.) On Models FB, T the thrust bearing is lubricated from the transmission. See page 72 and 73.

Weak Clutch Spring

This seldom occurs, as the action on the spring is very light. However, if none of the above conditions are the source of trouble, renewing the spring will usually correct the difficulty. (See Page 71.)

Transmission

The transmission is of the selective type, having three speeds forward and one reverse. It is composed of a countershaft on which are keyed three gears and a main or splined shaft, on which two gears slide, which by a lengthwise movement can be made to engage the gears on the countershaft (Fig. 69).

The most frequent source of annoyance is in having the gears jump out of engagement. This is usually produced by one or more of the following causes:

FIRST: Gears not meshed deep enough, causing the load to be carried on a part of the teeth only. In making the gear shifts always be sure, before engaging the clutch, that the gear-shift lever has been moved as far forward or backward as it will go without straining. If this is not done the edges of the teeth will become beveled, and in time it will be impossible to keep the gears engaged.

SECOND—Worn gear-shift rods or weak plunger springs.

The gear-shift forks (Fig. 69) are attached to two sliding shafts. There are three notches to each shaft, which are so spaced as to corre-

spond with the different gear-shift positions. In time the edges of these notches become worn so that the plungers do not secure a proper "grip." Also the plunger springs weaken. By removing the floor boards and watching the action of these shafts and noting the "play" between the gear-shift lever and the rods a fair idea of the trouble may be gained.

Observation will also show the location of the plungers, which can be removed by unscrewing.

THIRD: Bent gear-shift forks.

The shifting forks may be bent, not allowing the gear to come fully in mesh with the companion gear. To determine this, place the shifting lever in the position of the speed desired, then remove the cap screws which hold the transmission cover in place and raise the cover. You can then readily determine from the position of the sliding gear, its relation to the companion gear.

FOURTH—Loose or worn sliding gears.

Occasionally the sliding gears will become loose on the spline shaft, allowing the gears to canter or cock on the shaft.

This condition is brought about by excessive wear produced by lack of proper lubrication, and is best detected by having the gears jump out of mesh when passing over rough spots, or when coasting. Replacement of the gears or shaft is the only remedy.

If transmission becomes noisy or grinds when the motor is running idle with the clutch engaged, it may be due to the transmission being out of alignment with the motor. The main drive shaft bearing being worn or broken or idle gear bushing may be worn.

Replacing Worn Parts

Normal wear will in time require the renewal of bearings and bushings. (See Pages 78 and 79 for disassembling.)

Rear Axle

The rear axle used on all Models is known as a three-quarters floating, the load being carried by the wheel hubs running on bearings mounted in the axle housings. The function of the axle shafts is to rotate the wheels and hold them in an upright position.

Properly lubricated, the rear axle will give no trouble; however, continued use will in time produce wear.

Rear Axle Noises

This can be subdivided into two classes

FIRST: A normal and natural steady hum which is sometimes present when gears are used, whether in an axle or otherwise. The motorist should not become alarmed if the noise continues steady and uniform.

SECOND: Lumpy, jerky noises usually produced by wear. Occasionally one or more teeth may have become broken. There is no absolute method of diagnosis except to disassemble the axle and examine and try the fit of each working part. (Pages 82 to 94).

A rear axle is divided into three component parts:

(a) A propeller shaft, which is the connecting shaft between the transmission and the axle proper (Figs. 77, 78, 80, 82, 84).

(b) A differential, whose function is to permit one wheel to travel faster than the other, or independent of the other, such as turning corners, etc.

(c) The main or driving shafts to which the rear wheels are secured.

Each of the above are properly supported on bearings mounted in suitable housings. By following the description covering the disassembly and assembly of the different units on pages 82 to 94 the proper repair of the system should not be a difficult task.

The following hints will give a general idea of the probable source of difficulty should occasion demand.

Rear Wheels Will Not Rotate

(a) Remove the hub caps and note if axle shafts revolve. Occasionally the key holding the wheel hub to the axle shaft shears off.

(b) Remove the cover on the transmission and note if the spline shaft revolves. If it does, the trouble may be looked for at either of the following places:

FIRST: Broken Key on Drive Pinion.

SECOND: Broken Key on Differential Side Gears.

THIRD: Rivets or bolts sheared on Differential Bevel Gear Case.

FOURTH: Broken Propeller Shaft Thrust Bearing or adjustment loosened up which allows drive pinion to slide out of mesh with the Bevel Gear.

FIFTH: Broken universal joint or propeller shaft.

Grinding Noises When Turning Corners

This is an indication that the Differential thrust bearings or the Differential spider are worn. Replacement and proper fitting is the only remedy.

Axle "Bucks or Clashes" When Coasting

May Be Due to One or All of the Following:

FIRST: Worn or improperly adjusted Propeller Shaft Thrust Bearing.

SECOND: Worn Drive Gear or Pinion.

THIRD: Worn Universal Joint. (See page 79.)

FOURTH: Loose Rear Axle Shaft Wheel Key.

FIFTH: Worn Bushing in the Transmission drive gear.

SIXTH: Loose Rivets or screws holding Drive gear to differential gear case.

SEVENTH: Worn Differential spider pins.

Brakes

Brakes are the "safety factors" of an automobile, and yet it is safe to say that the average motorist seldom gives them any thought until they have become so worn as to be ineffective.

Brake Linings

These are made from woven asbestos and copper wire.

If the brakes are not properly adjusted so that the linings bear evenly and with the same pressure on the drums, their life, no matter how well made, will be comparatively short.

Brakes "Howl or Squeak" When Applied

This is due to the brake linings becoming worn so that the heads of rivets holding the linings to the bands strike the drum, or the surface of the lining has become glazed. If the rivets protrude, remove the bands and sink the rivet heads below the lining. If the linings are too thin renew them.

Car Skids, or One Wheel Locks When Applying Brakes

The brakes are not adjusted evenly; that is, those on one wheel grip before those on the other. Jack up the rear end of the car and adjust the pull rods between brakes and brake shaft (Pages 100 to 108) so that both right and left brake bands grip the wheels evenly with the same pressure and at the same time.

Brakes Will Not Hold on a Hill

This indicates that the lining is not bearing evenly and is gripping on half of the band only. (See Pages 100 to 108.)

Car Steers Hard

This is usually caused by any one of the following:

Steering gear needs lubrication.

Steering knuckles need lubrication. This is one of the most common causes.

Front tires not properly inflated.

Wheels not in proper alignment. To properly grip the road, the wheels should "toe" in at the front. (See page 81)

The bolts holding the steering gear to the frame may have become loosened.

If front wheels "shimmy" see page 62.

Front Tires Wear Unevenly

This is due entirely to the front wheels not being properly lined up. (See Page 81 for front wheel alignment.)

Chapter II

Practical Methods for the Repair and Maintenance of Chevrolet Cars

Removing Cylinder Head

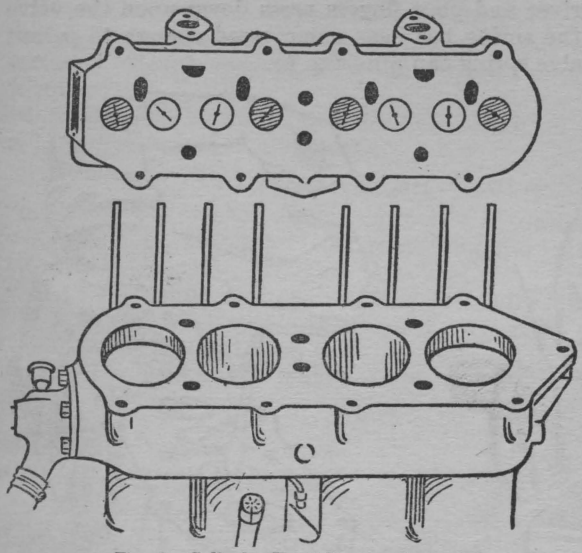


Fig. 2—Cylinder Head Removed.

Drain water by opening the radiator drain cock.

Disconnect the upper radiator hose connection and radiator tie rod.

Remove the hex. head cap screws holding the valve rocker caps and lift the assembly as shown in (Fig. 3).

Remove each of the eight bolts holding the cylinder head to the block.

Disconnect intake and exhaust manifolds.

Lift off the head (Fig. 2). The valve push rods will remain in position shown.

Clean all carbon deposits from cylinder head, top of piston and walls of combustion chamber.

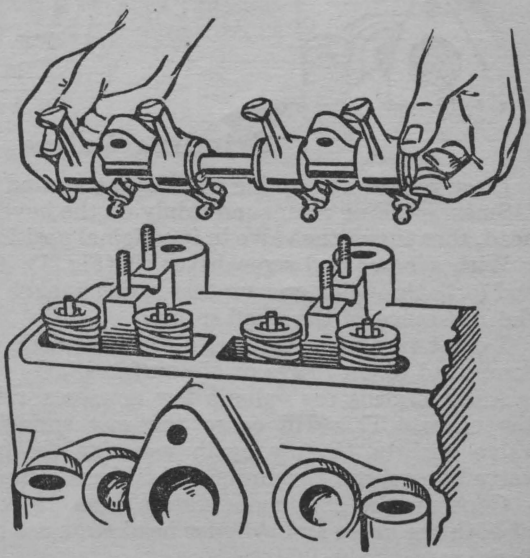
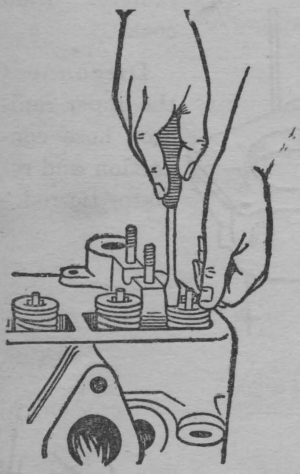


Fig. 3—Rocker arms and shafts removed

Removing Valve Spring

With a screwdriver and your fingers press down upon the valve spring cap until the spring has been compressed enough to permit pulling out the valve spring cap pin (Fig. 4).



ig. 4—Removing valve springs.

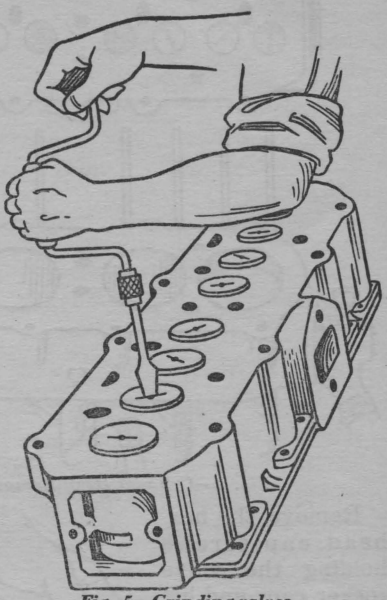


Fig. 5—Grinding valves

Grinding Valves

Place a light coil spring 1¾ in. long around the valve stem.

Smear grinding compound thinly on the beveled edge of the valve head, then insert the valve in its original position.

With a brace and screwdriver bit (Fig. 5), turn the valve back and forth through a quarter turn, using enough pressure to overcome the resistance of the small spring.

Do not turn valve through a complete circle, as this will cause the compound to cut ridges on the surfaces.

After rotating the valve a few moments, release the pressure on the brace. This will cause the coil spring to act, lifting the valve slightly. Before again reseating for further grinding turn valve one-quarter revolution. Add fresh compound when necessary.

Continue the grinding operation until the entire contact surfaces of both the valve and cylinder head seats are polished and show no dark spots.

To test for perfect contact, mark lines with a lead pencil about ¼ in. apart on the beveled edge of the valve head and reseat the valve.

Give the valve one half turn to the right and one half turn to the left, using a little extra pressure on the brace.

If all pencil marks are removed the grinding is perfect, if, on the other hand, one line or part of one remains untouched, the fact indicates an uneven spot, and the valve must be reground until it seats properly.

Before replacing valves in cylinder head clean all grinding compound from valves and valve ports.

Valve Grinding Tool

Fig. 132 illustrates a valve grinding tool for regrinding the seats on valves, also a reseating tool for reforming the valve seats in the cylinder head.

With this grinding tool, valves that are badly pitted or burned can be reground with a perfect seat in a very short time.

If the heads of the valves are warped, this operation makes them true with the stem.

Polishing Valve Stems

To Remove All Particles of Carbon and Grit

Hold the valve head between wooden blocks clamped in the jaws of a vise (Fig. 6).

Wrap a narrow strip of emery cloth around the valve stem and pull the ends back and forth, at the same time causing it to slide up and down on the stem.

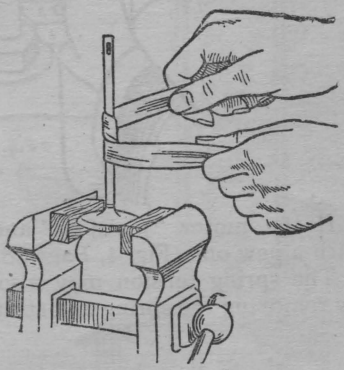


Fig. 6—Polishing valve stems

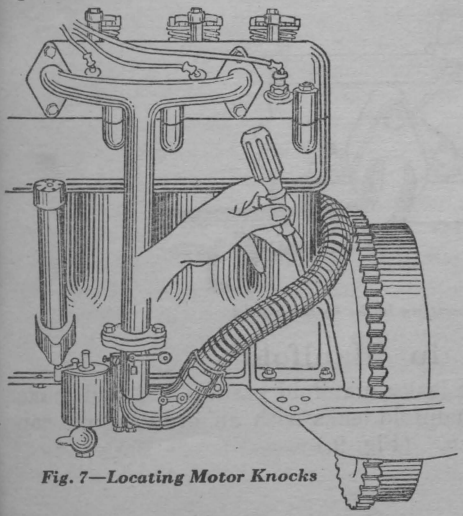


Fig. 7—Locating Motor Knocks

Listening for Motor Knocks

Fig. 7 demonstrates the most practical method of locating the knocks or pounds which often occur in a gasoline motor. While the motor is running, hold one end of a screwdriver, rod, piece of pipe, or piece of wood, to the ear and place the other end at different points on the crank case of the motor. The sound will be transmitted along

the screwdriver or rod, and the exact location of the noise may be determined.

Testing Tension of Valve Springs

Insert a screwdriver or some other suitable tool between the coils of the valve spring while the motor is running (Fig. 8.)

Twist or turn the screw driver, thus increasing the spring tension.

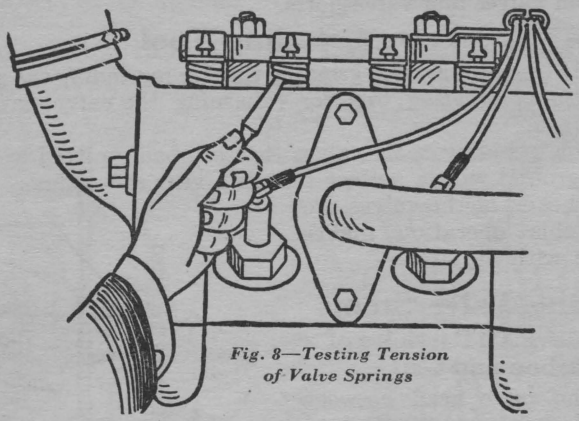


Fig. 8—Testing Tension of Valve Springs

If the motor "picks up" and runs properly, replace the spring with a new one (Fig. 4, Page 28.)

The spring tension may also be increased for a short time by removing the spring and stretching it about an inch.

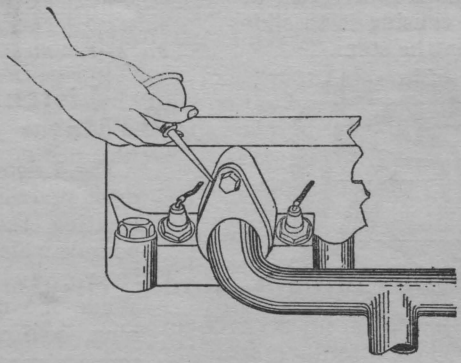


Fig. 9—Locating leaks in manifold

Leaks in Manifold

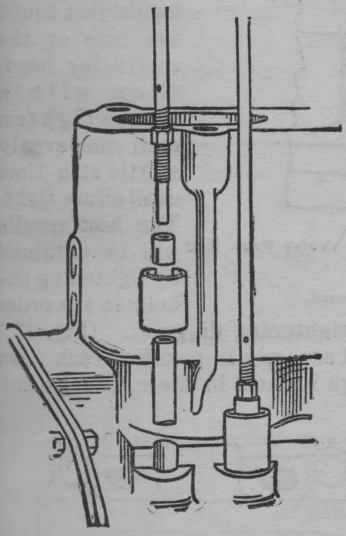
Constant vibration causes leaky manifold gaskets and will make the motor miss. Test for manifold leaks with an ordinary oil can filled with gasoline, as shown. (Fig. 9.)

Proceed slowly, squirting a little gasoline along the edges of each gasket.

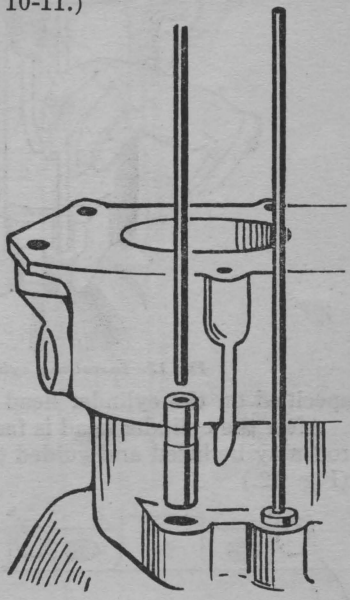
At the point where the leak occurs the gasoline will be sucked in and the motor will "pick up" and run properly for a few seconds. Remove and examine the gasket, replacing it if it is broken or shows any evidence of weakness. Should the leak be in the manifold, it can sometimes be brazed; however, a new manifold is the best solution.

Removing Valve Push Rods and Lifters

After the cylinder head is removed, the valve push rods, locks and valve lifters may be lifted out. (Figs. 10-11.)



Model FA, FB, T
Fig. 10—Push rod and valve lifter removed



Models Four-Ninety, Superior and G
Fig. 11—Push rod and valve lifter removed

Installing Cylinder Head

Remove valve lifters from the cylinder block. (Figs. 10 and 11.)

Remove the valve lifter locks from the rods.

Drop the push rods through the valve lifter holes to the camshaft. (Fig. 12.)

The old cylinder head gasket may be considered in good condition, and may be reinstalled if the copper linings surrounding the pistons and water circulation holes are free from marks or depressions and the surface is smooth and unbroken.

Shellac should never be placed on a gasket when installing a cylinder head. A thin film of cup grease applied to both sides of the gasket will hold it in position on the cylinder block while the head is being installed

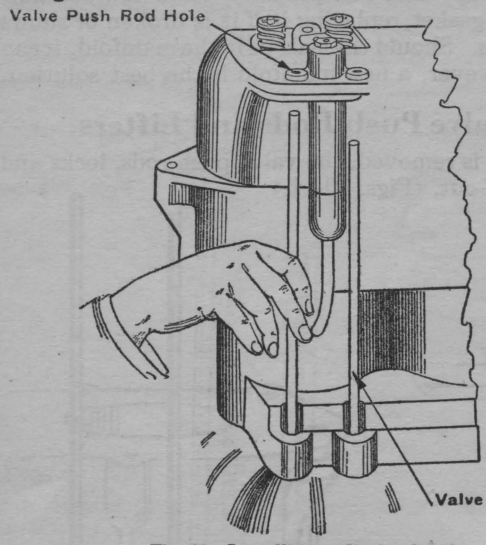


Fig. 12—Installing cylinder head.

After the gasket is in position on the cylinder block, put the head in place and install the eight bolts.

Screw each bolt in place until the heads just touch the boss on the cylinder head, then with a wrench tighten each one evenly a little at a time until all are tight. The best results will be obtained by tightening the bolts in the order specified on the cylinder head bolt tightening diagram. (Fig. 13.)

After the cylinder head is fastened securely in position, each push rod may be lifted and guided through its hole in the cylinder head. (Fig. 12.)

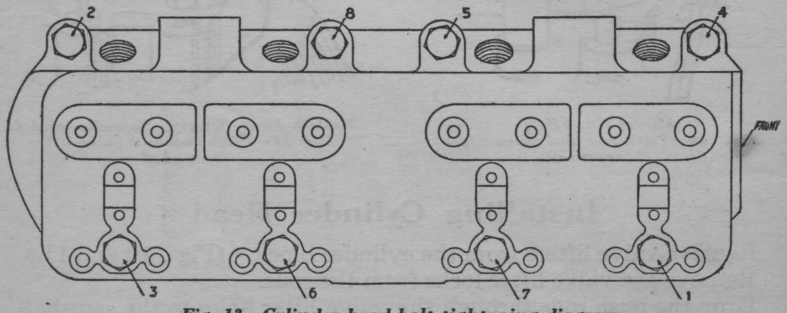


Fig. 13—Cylinder head bolt tightening diagram

Replace the valve lifters and locks in their proper position against the camshaft.

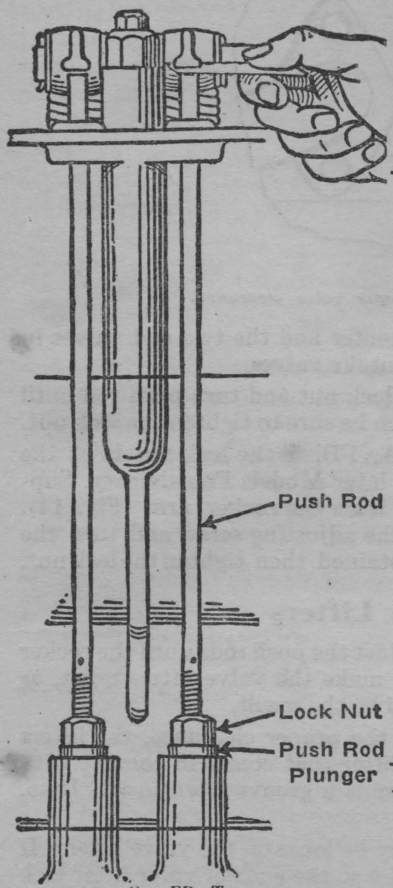
Install push rods in locks.

The push rods may be removed or installed without removing the cylinder head.

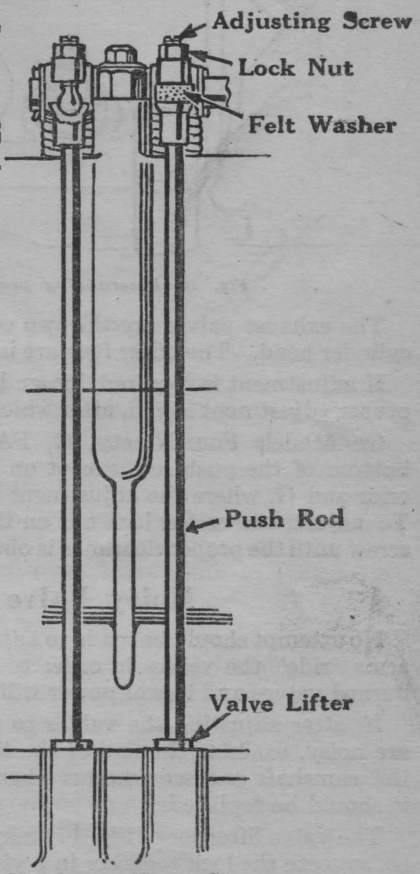
Adjustment of Valve Push Rod

Crank the motor by hand until the push rod being tested has reached its lowest point of travel.

Measure the space between the push rod and the valve rocker arm, Models FA, FB, T (Fig. 15) and between the valve stem and rocker arm, Models Four-Ninety, Superior. G (Fig. 14).



FA, FB, T
Fig.15—Adjusting Valves



Models Four-Ninety, G
Fig. 14—Adjusting valves

The space between the rocker arm and the end of the valve stem or push rod, should be about .006 of an inch on the intake valves and about .008 of an inch on the exhaust valves when the valve is seated. For determining clearance use a standard thickness gauge as shown in (Fig. 37, Page 51.)

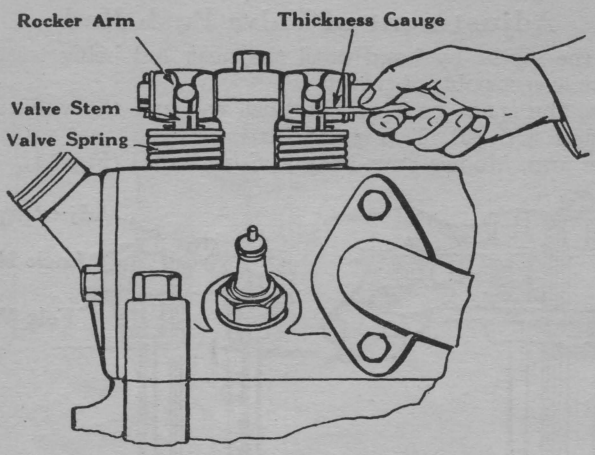


Fig. 16—Determining proper valve clearance.

The exhaust valves are the two center and the two end valves in cylinder head. The other four are intake valves.

If adjustment is required, loosen lock nut and turn push rod until proper adjustment is had, after which be sure to tighten the lock nut.

On Models Four-Ninety, G, FA, FB, T the lock nut is at the bottom of the push rod, except on later Models Four-Ninety, Superior and G, where the adjustment is on the rocker arm (Fig. 14). To adjust, loosen the lock nut on the adjusting screw and turn the screw until the proper clearance is obtained, then tighten the lock nut.

Noisy Valve Lifters

No attempt should be made to adjust the push rods until the rocker arms "ride" the valves in order to make the valve lifters quiet, as burned valves and loss of power will be the result.

If, after adjusting the valves to the proper clearance, the lifters are noisy, examine the end of the lifter that comes in contact with the camshaft and see whether there is a groove worn in it. If so, it should be replaced.

The valve lifter lock (Fig. 17) may be loose on the valve lifter. If so, squeeze the lock together in a vise so the ends of valve lifter lock point inward as in Sketch B. The back of valve lifter lock will then press firmly against the valve lifter when installed. Sketch C.

If it is found this does not eliminate the noise, inspect the rocker arm to see whether or not the surface that rests on the push rod or valve stem is worn. If so, grind or file off the rocker arm in an oval shape at this point.

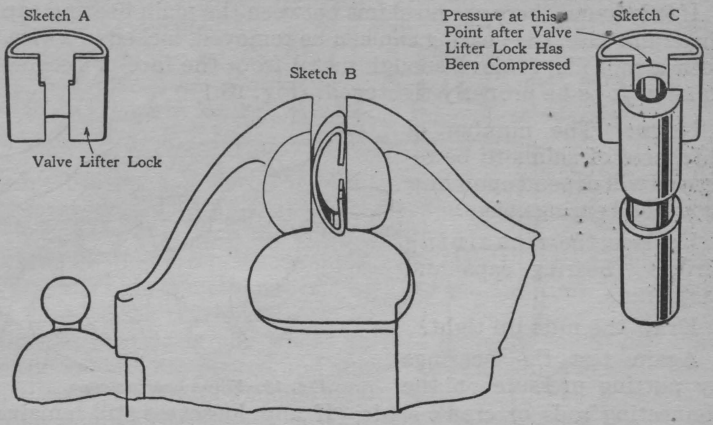


Fig. 17—Reshaping valve lifter locks.

Motor Bearings

After continued use the connecting rod and crankshaft bearings will become worn, producing a dull thud or pound, especially noticeable when the motor is suddenly accelerated or speeded up.

When the bearings were originally fitted at the factory the upper and lower caps of the bearings were separated by several thin metal sheets called shims, an equal number on each side, these ranging from three thousandths to ten thousandths of an inch thick.

Tightening Loose Bearings

To tighten bearings proceed as follows:

Remove the metal under pan from frame.

Drain oil from oil pan by removing plug from bottom of pan.

Remove lower oil pan. To tighten the crank shaft bearings on the Model "FB" it is also necessary to remove the sub-base by removing the cap screws holding it to the cylinder block.

Locate the loose bearing. By putting pressure on the connecting rod or crankshaft any looseness can be detected. Be sure to examine all bearings carefully as it may save you the trouble of again removing the lower crank case.

Remove the cotter pins from the castle nuts on the bearing cap bolts.

Take off the bearing caps and lower half of bearing.

CAUTION—Be very careful in removing to keep the two sets of shims separate.

Remove an equal number of metal shims from each side of the bearing caps.

If it is found there are no shims between the main bearing cap and the crank case, the bearing cap can be removed, locked in a vise, and with a mill file, remove enough metal from the face of bearing cap to allow it to be properly tightened. (Fig. 18.)

NOTE: The number of thickness of shims to be removed will depend upon how loose the bearings were.

Replace the remaining shims, bearing caps and castle nuts.

Draw the nuts up tight.

Again test the bearings by putting pressure on the connecting rods or crank shaft. If any looseness still remains, remove the caps and take out additional shims. If no apparent looseness exists, turn the motor over by hand and note the effort required.

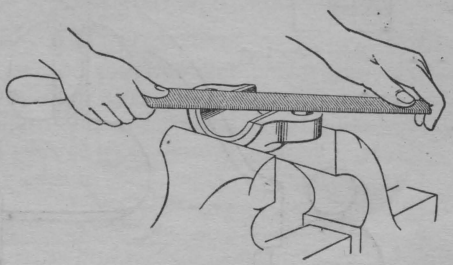


Fig. 18—Filing bearing caps.

If more than one bearing is loose, each bearing should be tightened separately and when the proper adjustment has been secured, loosen the castle nuts sufficiently to take the pressure of the bearings from the crankshaft. Then proceed to the next bearing in the same manner.

Considerable care should be exercised not to get the bearings too tight, otherwise there is danger of scoring or burning them. A scored or burned bearing must be refitted, which requires scraping and much additional time so be careful—take your time and be sure you are right.

After the proper adjustments have been secured on all bearings, the castle nuts can then be tightened and the cotter keys installed.

Connecting rod bearings that are fitted too tight will often produce a piston or piston pin knock, providing the piston or piston pins are worn to any extent.

After replacing the oil pan and connecting the oil pipe, fill with an over-supply of oil and allow the motor to run idle under its own power for some time.

When you are satisfied that the bearings have "worked in" properly, start the car and run it very slowly for several miles. A bearing which has been set up snug will heat readily at first, therefore the danger of scoring or burning is very great until the bearing has had time to "work in," so take your time—it may inconvenience you, but in the end it will save you many hours and unnecessary expense.

Tightening Main Bearings (Superior Model)

To tighten Main Bearings on Superior Model remove the bolts which hold the motor to the front and rear cross members, and with a jack placed under the motor, raise to a sufficient height to allow bearing caps to be removed.

Scored or Burned Bearings

When a bearing has scored or burned, either from lack of lubrication or from having been set up too tight, and not properly "worked in," refitting the bearing is the only remedy.

A scored bearing is one whose surface has been slightly roughened, but where the babbit metal has not been burned and run. A bearing of this kind can be refitted.

A burned bearing is one whose surface is badly roughened and where the babbitt has melted and started to run. This bearing cannot be used and a new one should be fitted.

Do not remove the babbitt bearings from the bearing caps unless it is necessary to replace them. Should this be necessary, be sure to see that the new bearing is firmly pressed into the cap and rests snugly against the bottom.

CAUTION: The best results can be obtained in the use of Prussian Blue by spreading a very thin coat on the finger tip then applying to the bearing of the crank shaft sufficient to give it only a pale blue tint. Prussian Blue spreads quickly and if too much is used, more of the bearing face will show a "bearing" than is actually touching.

Scraping Bearings

Place the bearing in the jaws of a vise (See Fig. 19). The upper crank shaft bearings should not be removed as they can be scraped in their proper positions.

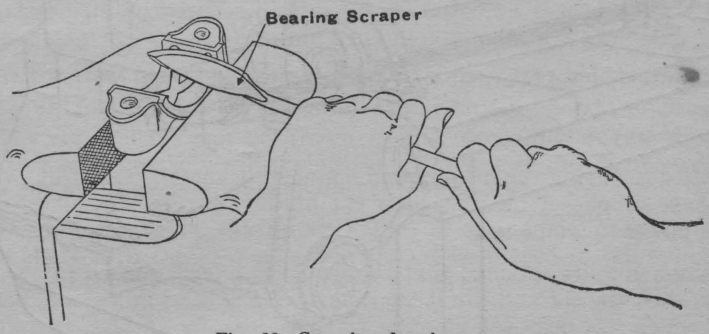


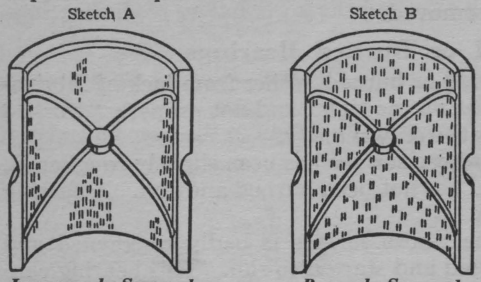
Fig. 19—Scraping bearings.

Hold a bearing scraper firmly with both hands.

With the cutting edge of the tool scrape off a little metal under each spot left by the Prussian Blue.

Care should be exercised in scraping bearings, as too much of the soft babbitt metal may be easily taken off.

Scrape very lightly, and test the surface often. Before testing wipe out the pieces of metal from the bearing.



Improperly Scraped Bearing *Properly Scraped Bearing*

Fig. 20—Showing bearing properly scraped and improperly scraped.

The object is to have the surface of the bearings and shaft touch at all points evenly.

The use of Prussian Blue shows the spots where the shaft touches, and by removing these "high spots" the bearing is finally worked down so that the shaft touches evenly at all points.

(Fig. 20, Sketch B.) indicates a bearing that is properly fitted and (Fig. 20, Sketch A.) shows one that is improperly fitted.

Fitting Crank Shaft Main Bearings, Upper Halves

To properly fit crank shaft bearings the motor assembly should be removed from the frame.

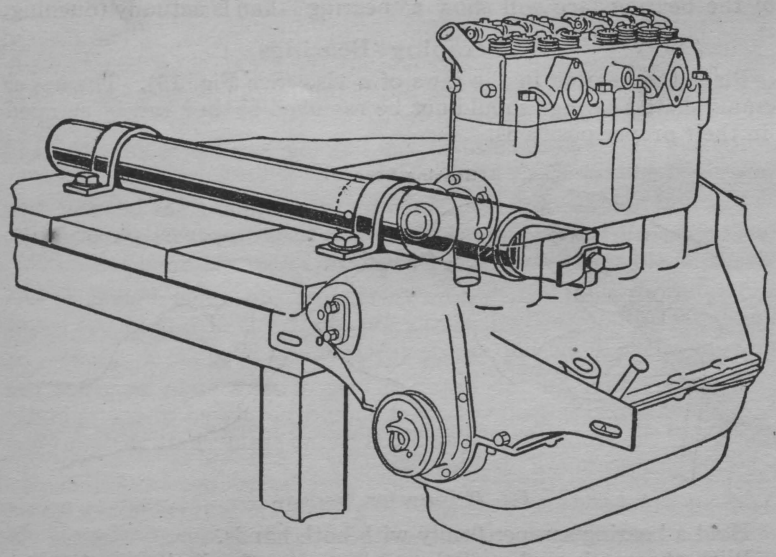


Fig. 21—Motor supporting fixture.

Remove the cylinder head, pistons and connecting rods, push

rods and crank shaft gear. Turn the cylinder block upside down either on a bench, on the floor or attach to a fixture as in (Fig. 21).

The upper halves of the crank shaft bearings should be fitted first, and this is best done by the method illustrated in Fig. 22.

Remove all three bearing caps and the lower halves of the bearings.

Lift out the crank shaft.

With the finger rub a thin coat of Prussian Blue on each bearing surface of the crank shaft.

Place the crank shaft in its natural position in the case and rock it back and forth with the hands (Fig. 22).

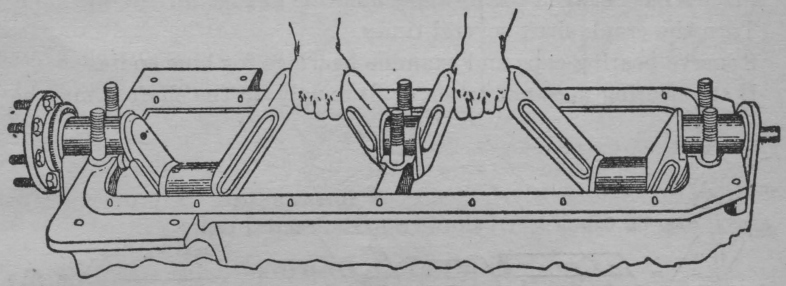


Fig. 22—Fitting crank shaft main bearings, upper halves.

Remove crank shaft and scrape the blue spots from the bearing. The blue spots indicate that the bearing and crank shaft rub at these points only, which are known as "high spots." The desired result is to scrape the bearings so that the crank shaft bears evenly at all points. This is an operation requiring much patience, so take your time, as it will pay in the end.

Repeat the operations until the bearing surface is smooth, and touches the crank shaft at all points.

The best results can be obtained by not installing the bearing caps until a perfect bearing is obtained on all three upper halves from the weight of the crank shaft only as in (Fig. 22).

The crank shaft can be drawn against the upper halves of the bearing cap, but this will spring the shaft out of line in the event any one of the upper halves are either high or low.

When scraping in the upper halves of new main bearings the cam shaft with the gear attached should be placed in the cylinder block and the crank shaft gear fitted to the crank shaft to determine whether the gears are meshing properly.

In the event the gears are worn to a certain extent it may be necessary to scrape the bearings deeper to get the proper mesh. There should be only a slight amount of lash after the bearing caps are drawn down tight.

Fitting Crank Shaft Main Bearings, Lower Halves

After the three upper halves of the bearings have been fitted (Fig. 22).

Install the crank shaft (Fig. 23).

Smear a thin coat of Prussian Blue on each bearing surface of the crank shaft.

Place the thin metal shims between the upper and lower bearing caps.

Replace all three bearings and tighten the bearing caps.

Place a bar between the flywheel bolts, as in Fig. 23.

Turn the crank shaft several times.

Remove bearing caps and examine bearings for blue spots.

If the bearing does not touch or fit snugly on the shaft it may be

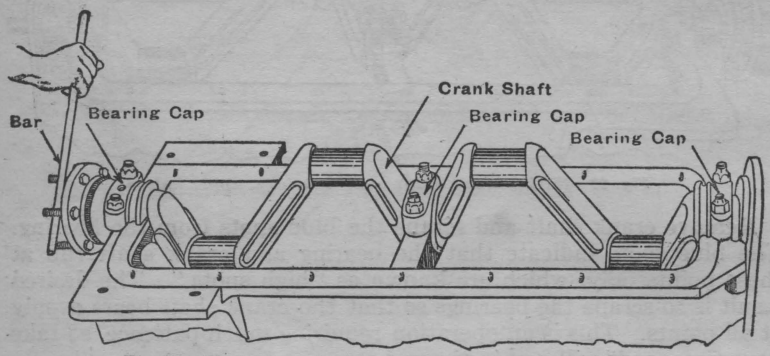


Fig. 23—Fitting crank shaft main bearings, lower halves.

necessary to remove equal number of shims from each side.

Scrape out the blue spots, as in Fig. 19.

Repeat the operations until the bearing surface is smooth and touches the crank shaft at all points.

After the bearing surfaces conform to those of the crank shaft, remove all Prussian blue from the shaft, lubricate the bearings well and install the bearing caps. Adjust each bearing separately to get the proper tension. Then tighten the caps down permanently and insert the cotter pins in the castle nuts.

Fitting Crank Shaft Main Bearings With an Aligning Reamer

A very satisfactory method of fitting crank shaft main bearings is with the use of a reaming tool as illustrated in (Fig. 24).

The upper and lower halves of the bearings are tightened in place. The reaming fixture is adjusted to the case and the bearings are reamed to the exact size of the crank shaft.

The crank shaft gear is placed on the reamer bar and meshes with the cam shaft gear when the reamer is being adjusted to insure a proper mesh of the gears.

After the bearings have been reamed, each bearing cap should be drawn down separately and sufficient shims used to get the proper tension.

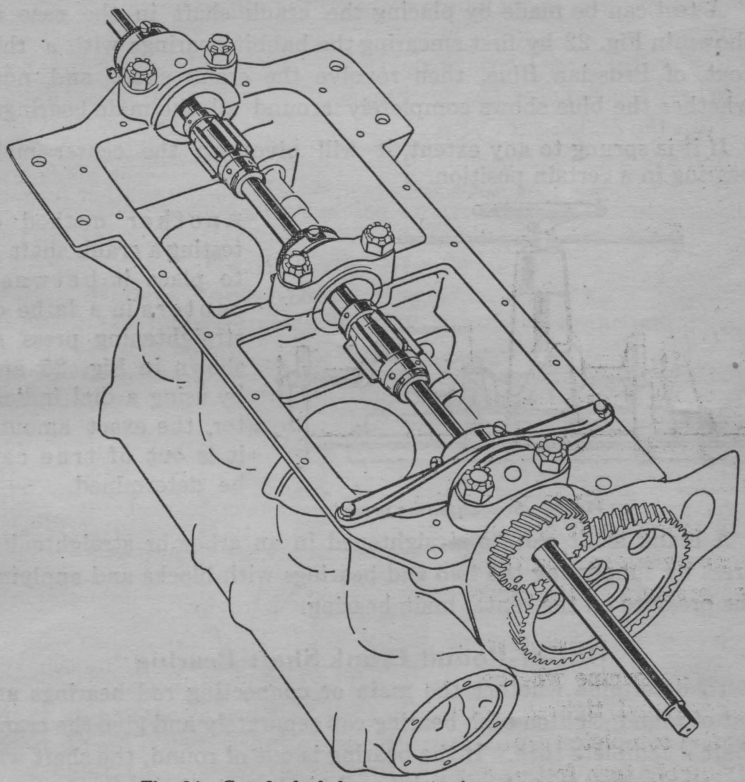


Fig. 24—Crank shaft bearing aligning reamer.

End Play in Crank Shaft

The end play in the crank shaft is governed by the bronze flange on the center crank shaft bearing, and when installing new bearings—or refitting an old bearing—care should be taken to see that about .006 of an inch clearance is allowed at this point.

To determine the clearance move the crank shaft backward and forward with a screwdriver or bar. Too much end play will often cause a pound or knock when the motor is running idle.

Sprung Crank Shaft

A sprung crank shaft will cause the bearings to loosen quickly and if the motor has been run for some time with loose bearings, the shaft should be tested to see if it is true before attempting to refit the bearings.

A test can be made by placing the crank shaft in the case as shown in Fig. 22 by first smearing the babbit bearings with a thin coat of Prussian Blue, then revolve the crank shaft and note whether the blue shows completely around all the main bearings.

If it is sprung to any extent, it will pivot on the center main bearing in a certain position.

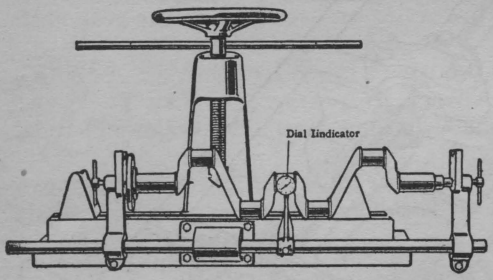


Fig. 25—Straightening press

Another method of testing a crank shaft is to place it between centers in a lathe or straightening press as shown in Fig. 25 and by using a dial indicator, the exact amount it is out of true can be determined.

A crank shaft can be straightened in an arbor or straightening press by supporting the two end bearings with blocks and applying the pressure on the center main bearing.

Out-of-Round Crank Shaft Bearing

To determine whether the main or connecting rod bearings are out of round, tighten each bearing cap separately and give the crank shaft a complete turn. If the bearing is out of round, the shaft will invariably turn free at one point and bind at another. Or measurements can be taken of the shaft bearings with a pair of outside micrometers.

If bearings are out of round they should be reground or turned in a lathe and polished.

Removing Crankshaft Gear

Drill two ⅜-in. holes 2⅛ in. between centers in a piece of flat steel ½-in. thick (See Fig. 26).

Drill and tap for a $\frac{5}{8}$ in. 10 x 3 in. cone point set screw, half-way between the two $\frac{3}{8}$ in. holes.

Insert two hexagon head machine screws $\frac{1}{16}$ in. 18 x 3 in. long through the holes in the bar into the threaded holes in crank shaft gear.

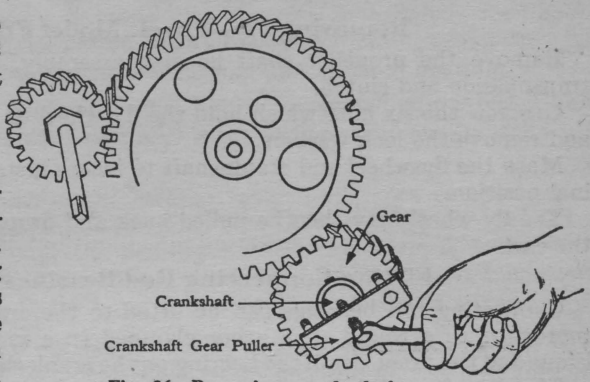


Fig. 26—Removing crank shaft gear.

Tighten the set screw, thus giving an even pull on the gear until it is removed.

Removing Fly-Wheel

Models Four-Ninety, Superior, G, FA, T

Remove the propeller shaft housing assembly, brake-pull rods, transmission and clutch.

On Models Four-Ninety and Superior disconnect and remove transmission supports and the wishbone hanger.

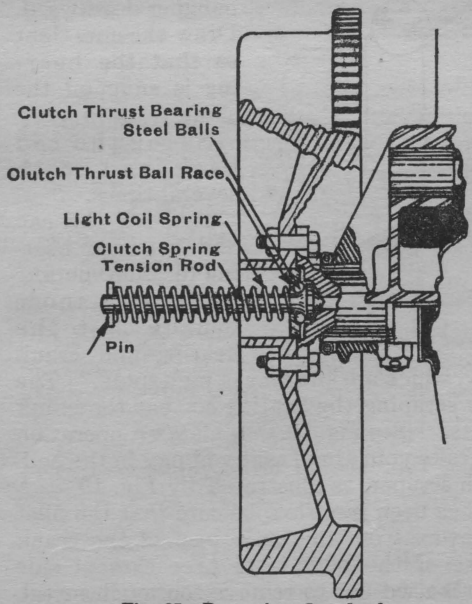


Fig. 27—Removing fly-wheel

Secure a light coil spring or piece of pipe having an inside diameter slightly larger than the spring tension rod, and 4 $\frac{1}{16}$ in. long, or equal to the distance between the clutch thrust, ball race and the pin hole in the rod. (See Fig. 27.)

Slip the pipe or spring over the tension rod and hold it in place by inserting a pin through the hole in the tension rod.

By holding the spring tension rod in its natural position the steel balls of the thrust bearing will be held in place and the rod and steel balls will come off with the fly-wheel when removed.

Mark the fly-wheel and crank shaft to insure installing in its original position.

Removing Fly-Wheel, Model FB

Remove the propeller shaft housing assembly, brake-pull rods, transmission and clutch.

Unscrew the six nuts which hold the fly-wheel to the crank shaft, and remove the lock washers.

Mark the fly-wheel and crank shaft to insure installing in its original position.

The fly-wheel may then be pulled back and dropped down under the car.

Fitting Connecting Rod Bearings

Connecting rod bearings can be fitted to the crank shaft in the motor, or to a round steel arbor clamped in a vise and which is ground to the exact size of the bearing on the crank shaft. (See Fig. 28.

The diameter of the connecting rod bearing on the crank shaft on Models Four-Ninety, Superior and G is 1⅜ inch; on Models FA, FB and T is 1½ inch.

Smear a thin coating of Prussian Blue on the connecting rod bearing of the crank shaft, or on the arbor.

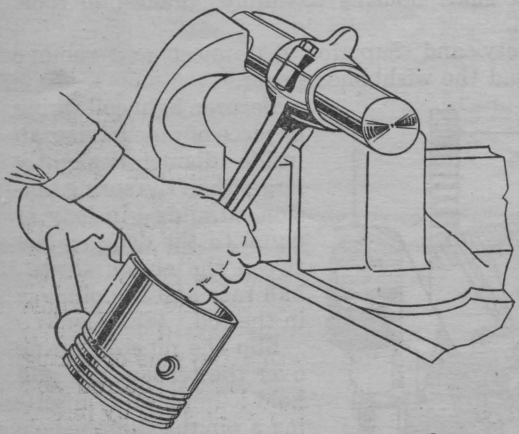


Fig. 28—Fitting connecting rod to an arbor.

Install the connecting rod on the crank shaft or arbor with the piston end hanging downward. Draw the nuts tight so that the bearing is snug on the shaft.

Swing the rod back and forth several times.

Remove the cap and examine bearing for blue spots.

The blue spots indicate that the bearing and crank shaft rub at these points only, which are known as "high spots." The desired result is obtained by scraping the bearing so that the crank shaft bears evenly at all points. (See Fig. 20.) This is an operation requiring much patience, so take your time, as it will pay in the end.

Remove "high spots" with scraper, as illustrated by Fig. 19.

If a new babbitt bearing has been installed, be sure that the fillet does not hold the bearing away from the main part of the crank shaft bearing. The purpose of the fillet is to take care of side thrust; however, unless care is used not to remove too much metal, this will not be accomplished.

In other words, a properly fitted bearing is one where the babbitt touches the crank shaft evenly and at all points, including the fillet. (Fig. 20, Sketch A, illustrates an improperly fitted bearing.)

Repeat the operation until all "high spots" are removed and the bearing surface is smooth and touches the crank shaft at all points.

With the point of the scraper remove all burrs or obstructions from the oil grooves. Remember that these grooves are to properly spread the oil over the bearing surface; therefore, it is necessary that there be no obstruction, also that they are deep enough. See that the oil hole is clear and lines up with the hole in the cap.

When the bearing has been fitted to the shaft, lubricate it thoroughly so there will be a film of oil on the bearing when the motor is started.

Installing Connecting Rods

When new connecting rods are installed, or, if new bearings are fitted, the connecting rod should be tested for alignment before and after it is fitted to the piston. The rod may be slightly twisted or bent and good results will be obtained only by having the piston pin parallel with the crank shaft bearing with the proper clearance between the piston pin bosses on the piston and the end of the connecting rod. Fig. 29 illustrates a fixture for this purpose.

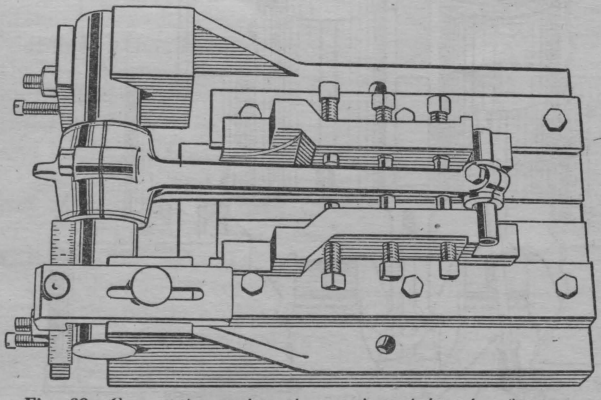


Fig. 29—Connecting rod testing, and straightening fixture.

After fitting the piston to the connecting rod, a further check can be made by clamping the connecting rod to an arbor as illustrated in Fig. 30 and testing for alignment with a combination or carpenter's square.

Removing Piston and Connecting Rod

Remove the cylinder head (See Page 27). Remove the metal under-pan from frame. Drain the oil from the lower crank case by removing the drain plug from the bottom of the case.

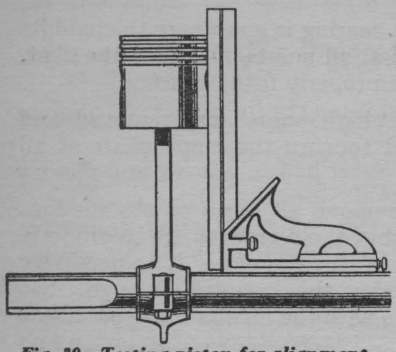


Fig. 30—Testing piston for alignment

On the Models Four-Ninety, Superior, G, FA, and T disconnect the oil pipes (See Fig. 45) from the lower crank case. Remove the lower crank case. On the Model FB it is also necessary to remove the baffle plates (See Fig. 46) in the cylinders.

Turn the crank shaft with the starting crank until the connecting rod cap has reached the lowest point of travel (See Fig. 31).

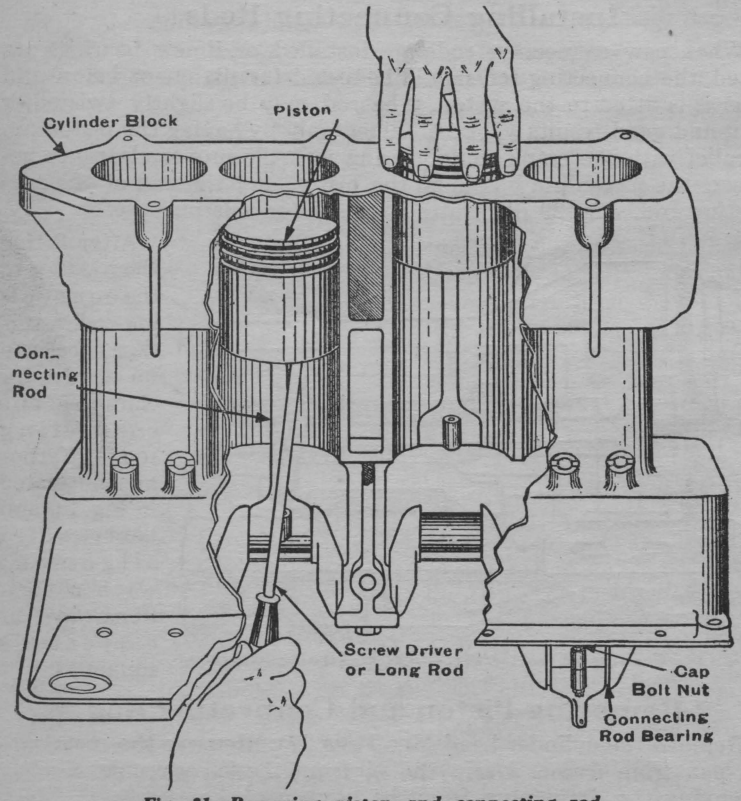


Fig. 31—Removing piston and connecting rod.

Remove the cotter pins from the castle nuts on the connecting rod cap bolts.

Mark each cap and bearing so that it may be installed in its original place and position.

Take off connecting rod cap and lower half of bearing and remove the connecting rod from the crank shaft. (See Fig. 31.)

Place the metal shims and connecting rod caps in their respective positions and screw the nut on the connecting rod bolts far enough to hold them in place.

With a hammer handle, long screwdriver or rod, placed inside the piston from below (See Fig. 31) push up, forcing the piston and connecting rod out until the bottom piston ring is above the top of the cylinder block, and has sprung out sufficiently to hold the piston and rod suspended in the cylinder wall.

Grasp the piston as shown, and lift out the assembly.

Removing Piston Rings

Raise the piston ring (See Fig. 32) and insert a table knife or hack saw blade. As the knife is slipped back of the ring and guided around the piston with one hand, the ring is forced out of the groove with the other hand

Remove the piston rings over the top of the piston and it will be found easier to remove the top ring first, then the center and lastly the bottom.

The piston and connecting rod may either be held in a vise or supported on a bench, as in Fig. 32.

If held in a vise, rest the bottom of the piston on the top of the vise and tighten jaws against connecting rod.

Be careful in handling a piston—its walls are light, and may be easily sprung, causing the piston to be out of round.

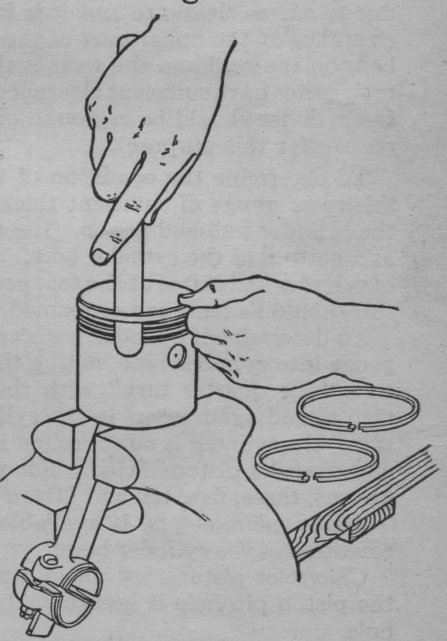


Fig. 32—Removing piston ring.

Removing Piston from Connecting Rod

To remove the piston from the connecting rod loosen the clamp screw and push out the piston pin.

Fitting Pistons

Fitting new pistons is often resorted to where the compression is weak or the pistons and valves carbonize readily, when in reality the difficulty is due to improperly fitted or worn piston rings. (See Page 50.)

Roughly speaking, the pistons should not be replaced until the motor has been in service a long time, and the cylinder walls have worn so that the pistons slap badly when ascending grades, or on hard pulls.

Do not confuse "carbon knocks" with "piston slaps;" remember that on a cold motor there is usually a slight metallic clicking which will disappear as soon as the motor heats up.

With a clean motor, that is, carbon removed from piston heads and valves and properly fitted piston rings, there is little need to consider replacement of pistons until after the cylinder walls have become worn to a considerable extent.

If it is necessary to replace the pistons on account of piston slaps due to excess clearance and it is found that by fitting to a proper clearance at the upper part of the cylinder where the piston rings bear on the wall and the wear is the greatest, that the piston binds or does not have sufficient clearance at the lower part of the cylinder, the cylinder should be reground or reamed. (Fig. 134 illustrates a reamer for this purpose).

To determine the condition of the cylinders, use a piston and a thickness gauge of sufficient thickness to fill up the space between the cylinder wall and piston. Insert the piston and gauge at the top and bottom of the cylinder bore. If the piston binds at the bottom of cylinder and is free at the top, you will know the cylinder is tapered and should be reground or reamed.

To determine if cylinder walls are out of round, insert piston with gauge into cylinder bore, noting the clearance. Remove piston and turn "one quarter turn" with the gauge in same position on the piston, and again insert in the cylinder. If the clearance is not the same, the cylinder is out of round and should be reamed or reground and oversize pistons fitted. For that purpose we carry a stock of pistons, three, five, ten and fifteen thousandths oversize.

Inside micrometers, if available, may be used to determine the condition of the cylinder bore.

Chevrolet pistons are made oval, that is, the diameter through the piston pin hole is less than the diameter at right angles to the hole.

This is done to prevent the pistons from scoring, as the greatest expansion takes place through the piston pin bosses.

In measuring the clearance between the piston and cylinder walls, always do it at right angles to the piston pin and on a line with it.

The Models Four-Ninety Superior and G are equipped with cast iron pistons and the clearance should be from 2½ to 3 thousandths of an inch.

The Models FA, FB and T are equipped with lynite pistons and the clearance should be about 3 thousandths of an inch.

To measure the clearance remove the rings from the piston and slip it into the cylinder.

Secure a narrow strip of sheet brass or steel three thousandths thick.

Insert this between the piston and the cylinder, sliding the piston well into the cylinder bore. (See Fig. 33.)

Then remove the gauge. For a properly fitted piston, some resistance should be felt, that is, you should feel the gauge "binding" on the piston and cylinder.

Do not attempt to fit the pistons closer than this, as some room for expansion must be provided, and our experience has shown this to be the inside limit.

Powdered emery, glass or other abrasives should never be used to "grind in" an oversize piston, for three reasons.

FIRST: A piston which is made oval cannot be ground true, except on a special grinding fixture.

SECOND: The grinding takes place on both the piston and cylinder walls, therefore, as the piston is oval the cylinders will be made "out of round."

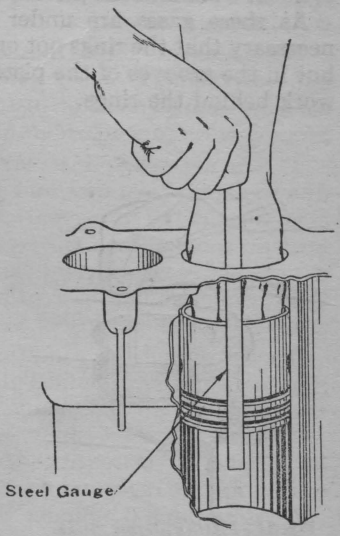


Fig. 33—Fitting pistons.

THIRD: The compound works into the pores of the cylinders, and no amount of washing or brushing will remove it. Therefore, it stays there and continues its job of grinding, making an early renewal of the piston and cylinder a certainty.

In almost every locality there are machine shops equipped to regrind or rebore cylinders and we recommend that when an operation of this kind is necessary, the work be instrusted to them, providing you do not have such equipment in your shop.

Piston Slaps

Piston slaps are most frequently caused by excess clearance between the piston and cylinder wall, although same can be attributed to bent connecting rods.

If it is caused by excess clearance, an oversize piston will eliminate it.

Connecting rods can be tested with the aligning device as illustrated in Fig. 29, Page 45.

Fitting Piston Rings

Too much stress cannot be laid upon the importance of properly fitting each piston ring. It is safe to say that very few consider it important, and as a result loss of power—badly carbonized valves and pistons and other cylinder troubles, result.

The purpose of a piston ring is to fill up the space between the cylinder walls and the piston, so as to prevent leakage of gases and oil.

As these gases are under considerable pressure, it is therefore necessary that the rings not only fit snugly around the cylinder walls, but in the grooves of the pistons as well, otherwise the gases and oil work behind the rings.

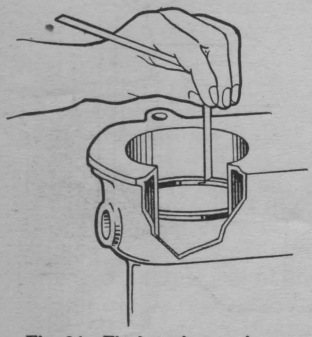


Fig. 34—Fitting piston rings.

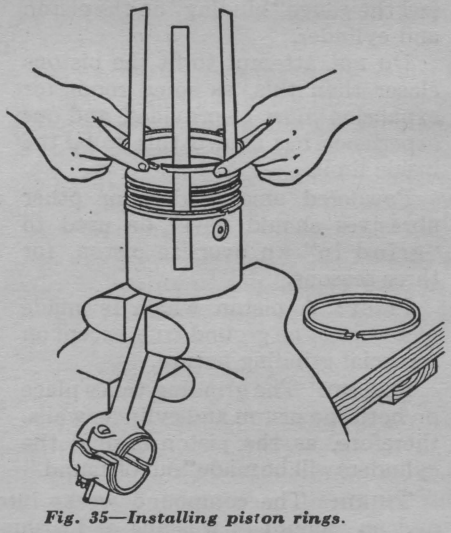


Fig. 35—Installing piston rings.

To properly fit new piston rings, proceed as follows:

Slip the ring into the cylinder, pressing it down about half way into the bore (See Fig. 34). See that the ring is square with the cylinder walls; that is, its plane should be at right angles to its axis.

Secure a narrow strip of brass or steel three one-thousandths of an inch thick and slip it between the two edges of the split in the ring. Make sure that the ring is resting in the cylinder in the same position that it would were it in the piston, then withdraw the gauge.

For a properly fitted ring, there should be a slight resistance, that is, you should feel the edges of the ring drag on the gauge.

If the space between the splits is less than this, remove the ring and with a very fine file dress the edge until proper clearance is

obtained. Be careful not to round the edges of the ring—keep the file flat. Fit each ring separately.

With a scraping tool carefully remove all particles of carbon from the faces of the ring grooves in the piston.

Slip the back side of the ring into the groove (See Fig. 36) and roll it entirely around the groove. If the ring is the proper thickness you should feel it drag slightly in the groove. If it is too loose, try another ring.

If too thick fasten the ring to a flat board (See Fig. 38) then lay a sheet of very fine emery cloth on a surface plate. Lay the board, ring down, on the emery cloth and with the hand resting lightly on the board slide it across the emery. Be careful to put pressure on the board evenly, so as to remove an equal amount of metal from the entire surface of the ring.

Remove the ring from the board and try the fit, repeating the grinding operation if necessary.

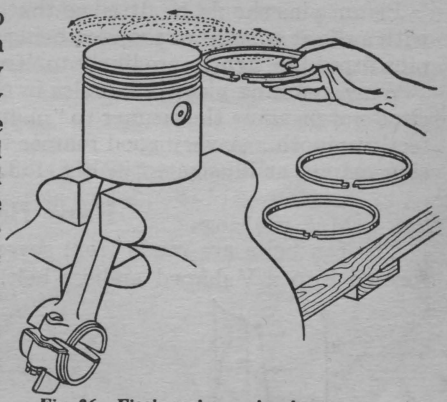


Fig. 36—Fitting piston ring in grooves.

Slip the rings into their grooves, starting with the lower ring (See Fig. 35).

Be very careful not to injure the edges of the ring, as these must not be broken in any way, otherwise trouble will result.

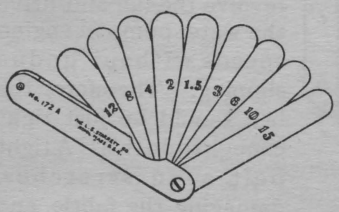


Fig. 37—Standard thickness gauge.

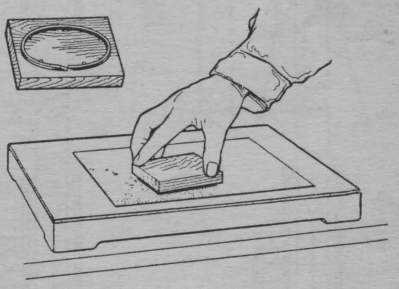


Fig. 38—Grinding piston rings.

In slipping the pistons back into the cylinders use extreme care —take your time and do not force the rings into the bore. Compress the rings with the fingers until they enter the cylinder easily.

The splits in the three rings should not be in a vertical line, as the gases could leak by more easily. Therefore stagger the splits so that they will be equally distant around the circumference of the piston.

Fitting Piston Pins

To determine if the piston pins are worn, clamp the connecting rod in a vise the same as in fitting piston rings. Take the piston in both hands and move it upward and downward and if there is any wear, it can easily be detected. If a standard size piston pin is too small an oversize pin can be installed. We carry in stock oversize pins .003" and .005".

Piston pins should be fitted so that the piston will rock on the pin with a slight amount of pressure being exerted with the hand. Piston pins fitted too tightly are likely to "freeze" and score the piston.

When reaming piston pin holes in the piston, care should be exercised not to allow the reamer to "chatter" as the hole should be perfectly smooth. A very good reamer for this purpose is a $\frac{13}{16}$" expansion reamer as illustrated in Fig. 133.

Fan Belt

The fan belts are made from several layers of vulcanized fabric formed into a V shaped endless belt. With this type greater belt surface is gained, permitting it to run much looser than would be the case with a flat belt. This not only means that the belt will work better and give longer service, but relieves the fan bearings of considerable strain. The purpose of a fan belt is to revolve the fan and drive the water pump at engine speeds without undue slipping. Therefore, the belt should be just tight enough to do this. A tight belt soon stretches, damaging the fabric and necessitating renewal.

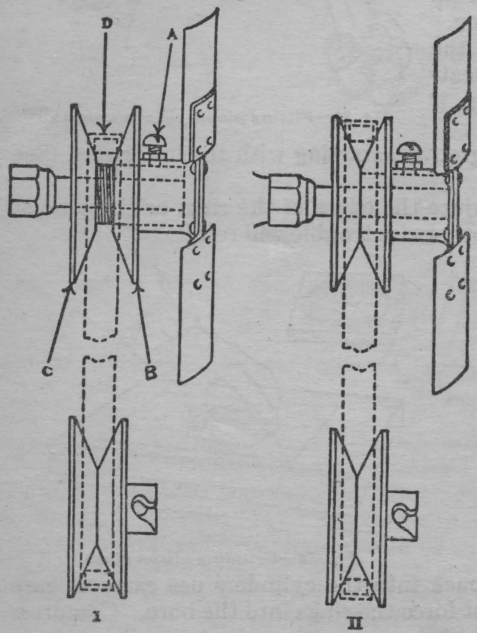


Fig. 39—Fan belt adjustment

To tighten the fan belt, remove set screw A, (See Fig. 39) and turn the adjustable flange (B) with the fan blades in the same direction as the hands of a clock, thus bringing it nearer the stationary flange (C), which will cause the belt to ride higher in the groove. A suitable spanner wrench for holding the stationary flange (C) is

illustrated in Figure 145. Be sure to insert the set screw and lock it with the nut when it is in line with either of the holes G or H, (See Fig. 40) in the stationary flange C.

Installing Fan Belt

Pass the fan belt between the radiator and over the fan blades, looping it over the adjustable fan pulley (See Fig. 40).

Loosen the jam nut holding set screw (A) (See Fig. 39).

Unscrew set screw (A) until it disengages the slot in the fan hub.

Turn the adjustable flange (See Fig. 39) opposite to the direction of the hands of a clock, until the fan blades touch the radiator. The belt (D) will now rest upon the threaded hub (See Fig. 39, Sketch I).

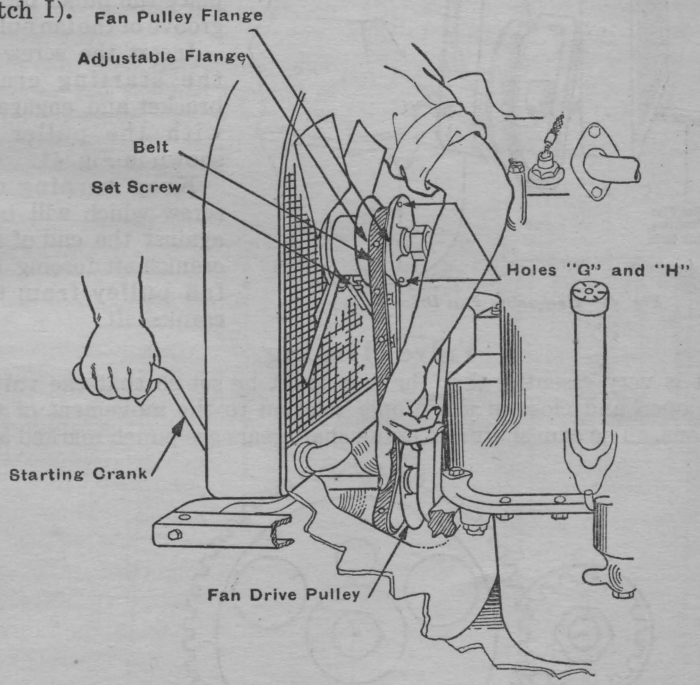


Fig. 40—Installing fan belt.

Insert the starting crank and turn motor, at the same time holding the loose end of the fan belt in the groove of the drive pulley (See Fig. 40).

Continue to turn the crank and at the same time hold the belt tightly against the drive pulley until it is completely in the groove.

Tighten fan belt by turning the flange (B) in the same direction as the hands of a clock,

Tighten set screw when it is in line with slot in fan hub.

Lock set screw with jam nut.

If the under pan interferes it may be pressed down with a screw driver to give room for the belt to pass between the pulley and pan.

Removing Fan Drive Pulley

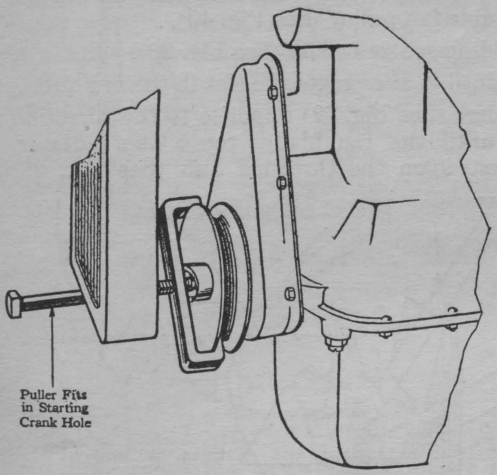


Fig. 41—Removing Fan Drive Pulley

To remove the fan drive pulley a very good puller is illustrated in Fig. 147.

Remove the screw from the puller and place the puller in the groove of the fan pulley

Insert the screw in the starting crank bracket and engage it with the puller as shown in Fig. 41.

Keep turning the screw which will bear against the end of the crankshaft forcing the fan pulley from the crankshaft.

Valve Timing

It is very essential that the cam shaft be set so that the valves will open and close in the proper relation to the movement of the pistons. The cam shaft and crank shaft gears are punch marked and

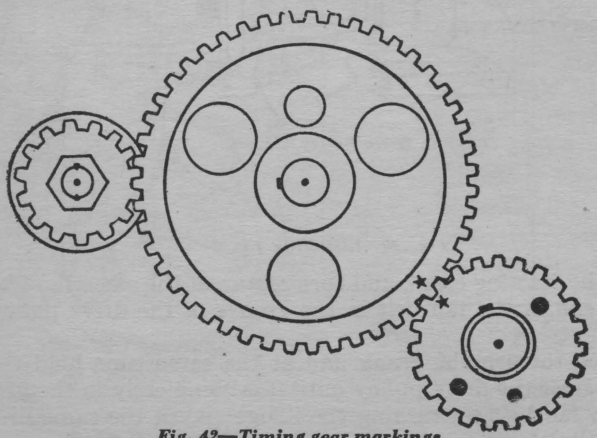


Fig. 42—Timing gear markings

if for any reason either of these gears are removed, the punch marks should line up as in Fig. 42 when they are replaced.

The finding of "top dead center" is accomplished by turning motor over with starting crank until No. 1 and 4 piston have reached their top position. To determine this position, if the cylinder head is not removed, remove spark plug and insert a screw driver or rod so one end will rest on top of piston (See Fig. 43).

You can then determine when the piston has reached the end of its upward travel, which is called "top dead center."

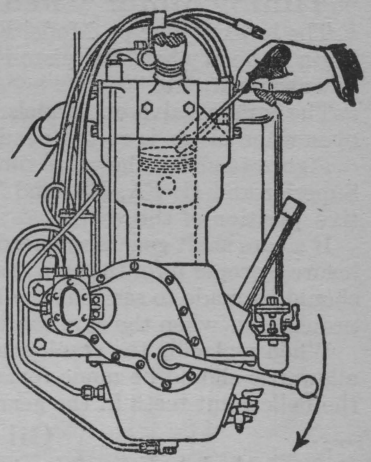
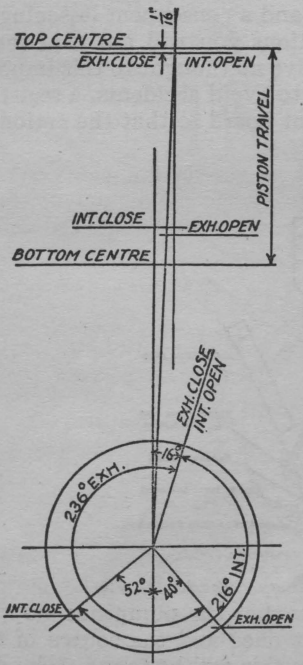
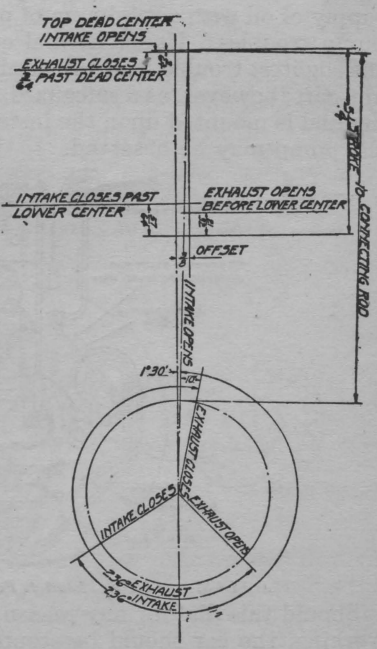


Fig. 43—Locating top dead center



Model Four-Ninety, Superior and G



Models FA, FB, T

Fig. 44 —Valve timing diagram

Timing Motor When New Gears Are Installed

The intake valve on Model Four-Ninety, Superior and G should begin to open when the piston has traveled $\frac{1}{16}$ of an inch on its downward stroke.

The intake valve on Models FA, FB and T should begin to open open when piston is on top dead center.

Figure 44 shows the valve timing diagram of Models Four-Ninety, Superior and G, FA, FB, and T from which can be seen the relative position of the valves.

If a cam shaft gear is replaced the cam shaft should be removed to insure a proper fit of the cam shaft thrust bearing and a careful check should be made to see that the No. 1 intake valve is opening at the proper time when the cam shaft is again placed in the motor.

When replacing the crank shaft gear with the cam shaft in place, allowance should be made for a slight turn of the cam shaft due to the helical cut teeth in the gears.

Oil Pump

Models Four-Ninety, Superior, G, FA, FB, T

Upon the oil pump depends the successful lubrication of the motor. The pump used has been simply designed to give a constant, even supply of oil with a minimum of parts and a consequent lessening of pump troubles. Under normal conditions you will not experience the slightest trouble, and will need to give no thought to this important part; however, as a safeguard, and to avoid accidents, a registering dial is mounted upon the instrument board so that the action of the pump may be observed.

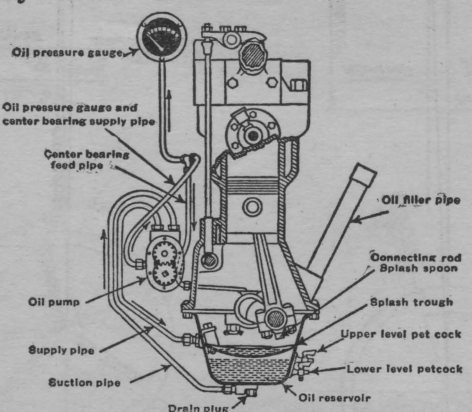


Fig. 45—Motor oiling, Models Four-Ninety, Superior, G, FA,

Should this dial for any reason show that the pump has stopped working, the car should be stopped at once and the source of the trouble located and remedied. Usually this will be found to be due to air leaks in the suction pipe (See Figs. 45 and 46) and can, in most

cases, be corrected by tightening the connections at the upper and lower ends. Occasionally dirt and unburned carbon will form as a sediment and be drawn into the suction and feed pipes, obstructing them, in which case they should be taken off and blown out.

After the car has been in service for a long time the small gears may become worn to the point where they will not function, in which case replacement of the gears is the only remedy, except on motors equipped with the plunger type pump in which event the plungers or pump body can be replaced.

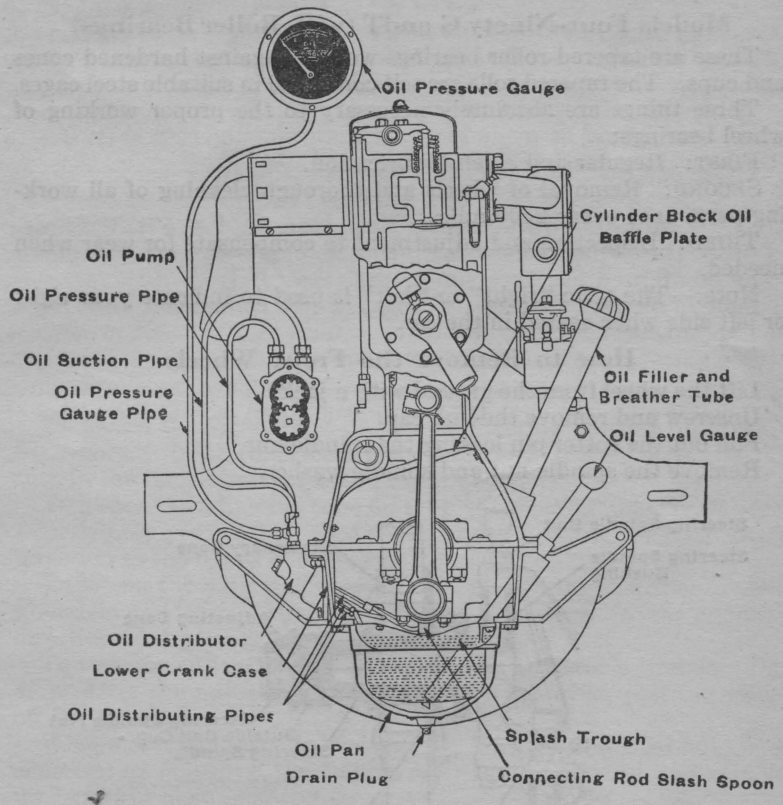


Fig. 46—Motor oiling, Model FB, T

When repairs have been made on the motor that necessitates the removal of the oil pump or oil pump feed lines, it is well to prime the pump with cylinder oil, by removing the suction line (one next to motor) and insert oil into the pump before the motor is started.

Get into the habit of noting the action of the registering dial regularly—not in the expectation of trouble, but to avoid its possibility.

Every few minutes, while the motor is running look at the dial—it only takes a second and requires no special effort. Failure to make proper observations may cost you in time and money several times this amount.

Adjustment of the Front Wheel Bearings

Models Four-Ninety, Superior, FA, FB (with Ball Bearings)

These are known as cup and cone bearings, on which the radial and lateral load is carried on ball bearings working between hardened cones and cups.

Models Four-Ninety G andT (with Roller Bearings)

These are tapered roller bearings working against hardened cones and cups. The tapered rolls are self contained in suitable steel cages.

Three things are absolutely necessary to the proper working of wheel bearings:

FIRST: Regular and careful lubrication.

SECOND: Removal of wheels and thorough cleaning of all working parts once every 2500 miles.

THIRD: Inspection and adjustment to compensate for wear when needed.

Note:—The term "right" or "left" is used to indicate your right or left side when seated in the car.

How to Remove the Front Wheels

Lift the wheel from the ground with a jack.

Unscrew and remove the hub cap.

Pull out the cotter pin locking the spindle nut.

Remove the spindle nut and spindle washer.

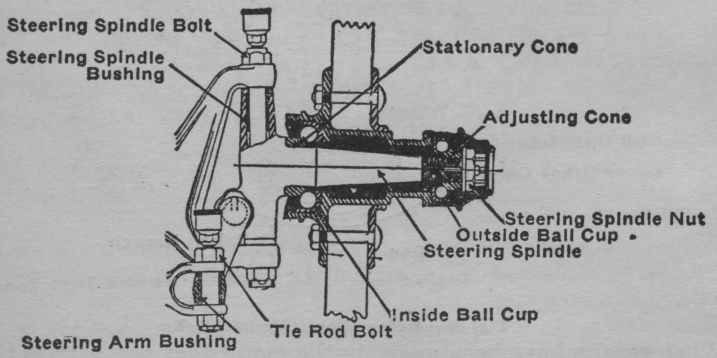


Fig. 47—Front wheel bearings, (ball)

To loosen the spindle nut on the right steering knuckle, Model Four-Ninety (with ball bearings) turn in the same direction of the hands of a clock.

To loosen the spindle nut on the left steering knuckle, Model Four-Ninety (with ball bearings) turn in the opposite direction of the hands of a clock.

To loosen the spindle nut on the right steering knuckle on Models Four-Ninety (with roller bearings), Superior, G, FA, FB and T, turn in the opposite direction of the hands of a clock.

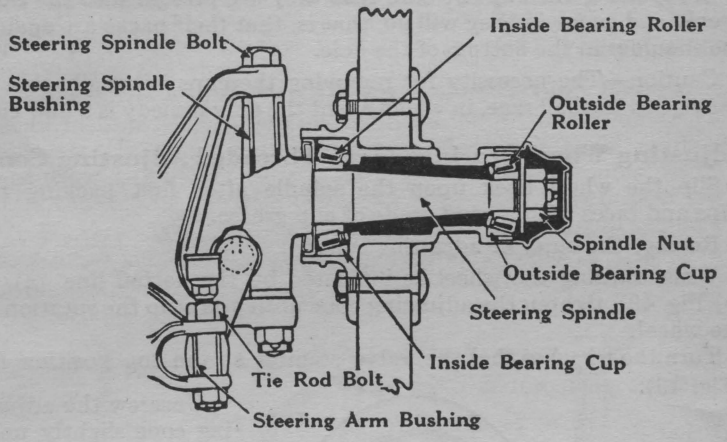


Fig. 48—Front wheel bearings, (roller)

To loosen the spindle nut on the left steering knuckle on Models Four-Ninety (with roller bearings), Superior, G, FA, FB and T, turn in the same direction as the hands of a clock.

To loosen the adjusting cone on the right steering knuckle, Models Four-Ninety (with ball bearings) and FA, turn in the same direction as the hands of a clock.

To loosen the adjusting cone on the left steering knuckle, Models Four-Ninety (with ball bearings) and FA, turn in the opposite direction of the hands of a clock.

To turn the adjusting cone grip it with an adjustable wrench. (Fig. 49.) After the adjusting cones have been removed, pull the wheel off the spindle.

Wheels containing roller bearings not having a threaded adjusting cone can be pulled off the spindle after the spindle nut and spindle washer have been removed.

The outside cone will usually remain in the wheel but can be removed with the fingers.

How to Remove Wheel Bearings

The ball bearings are held in the ball cups by spring steel retainer rings. These rings are split so that one end may be slipped out of its groove by inserting a punch or nail into the hole drilled in the end and contracting the ring.

The ball cups are pressed into the hubs and can be driven out by inserting a bar through the hub so that one end rests against the ball cup. By tapping lightly at several points around the circumference of the cup, it can be removed without damage. It is well to remember that the cups are very hard, therefore extreme care should be used in removing not to crack them.

In replacing the cups be sure that they are pressed into the hubs evenly and as far as they will go, that is, that their backs are against the shoulder in the bottom of the hole.

Caution—The necessity for removing the cups is usually due to damage to the ball race, in which event the only remedy is a new cup.

Adjusting Wheel Bearings (with Threaded Adjusting Cone)

Slip the wheel back upon the spindle after first packing the cups and races with a good grade of cup grease.

Replace the outer or adjusting cone.

While turning the wheel as indicated by the dotted line (a) to (b) Fig. 49), tighten the adjusting cone until you stop the rotation of the wheel.

Turn the wheel so that the valve stem is at the top position (a) (Fig. 49).

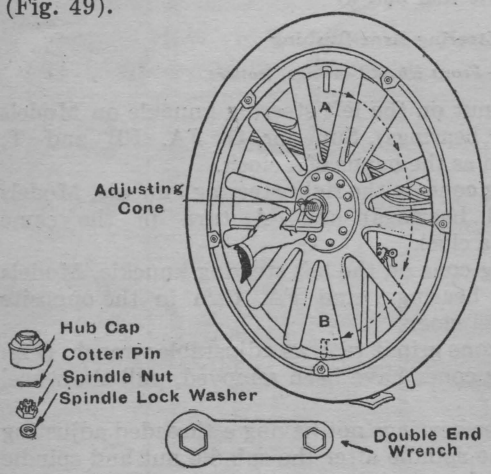


Fig. 49—Adjusting wheel bearings

Unscrew the adjusting cone slightly until the wheel again starts to rotate toward (b).

Replace the spindle lock washer.

Tighten spindle nut against washer. Tightening the spindle nut may cause the adjusting cone to become too tight.

Try adjustment on turning the wheel so that the valve stem assumes position (a) (Fig. 49). If the adjustment is proper, the wheel will rotate, otherwise the bearing will heat and will very likely be damaged.

When adjusting wheel bearings, it is sometimes advisable to insert a chisel or a small bar between the axle and the steering knuckle to insure that any play in the steering spindle bolt is not confused with play in the bearings.

Lock the spindle nut with the cotter pin.

Adjusting Wheel Bearings (with a Smooth Bore Outer Cone)

The inner cone should be placed on the spindle.

Pack the bearing cones and cups with a good grade of cup grease.

Slide the wheel on the spindle.

Slip the outer cone in place.

Replace the spindle nut and washer.

Turn the wheel as indicated by the dotted line from (a) to (b) (Fig. 49.) and at the same time tighten the spindle nut until you stop the rotation of the wheel.

Rotate the wheel so that the valve stem is at the top. Position (a) (Fig. 49.)

Unscrew the spindle nut slightly until the wheel again starts to rotate toward (b).

Lock the spindle nut with the cotter pin.

Front Wheels Alignment, All Models

Fasten securely one end of a stout cord around either right or left rear wheel hub. (Sketch 1, Fig. 50.)

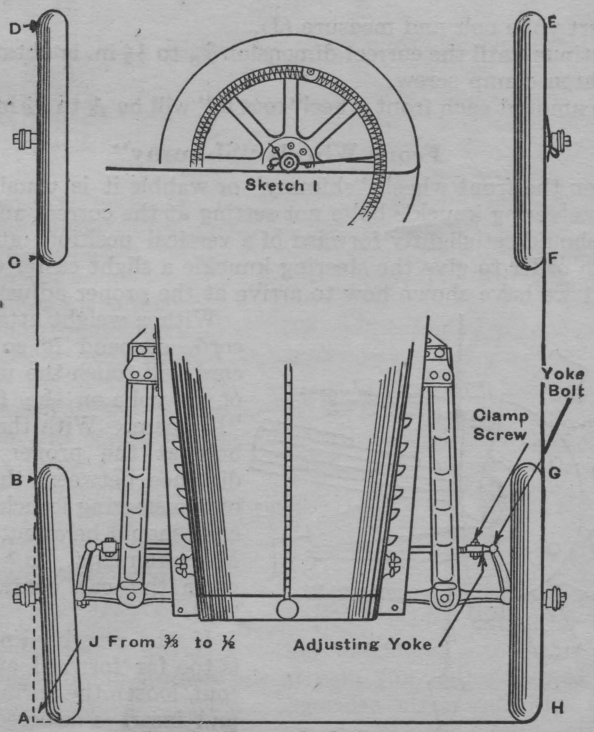


Fig. 50—Front wheel alignment

Pass the cord between the spokes toward the rear and around the tire, across the face of the wheel at the height of the hub. (Sketch 1, Fig. 50.)

Pass the cord completely around the front of the car across the faces of each of the wheels at the height of the hub, and tie the end around the tire at the point (D), (Fig. 50).

Turn the steering wheel so that the right front wheel is in line with the right rear wheel. The cord must touch the wheels at the points B, C, D, E, F, G, H.

The total amount the two front wheels "toe in" may then be determined by drawing the cord at (A) in a straight line, retaining the point of contact at (B). The dimension (J) measured from the cord to the tire should be from $\frac{3}{8}$ to $\frac{1}{2}$ in.

If Adjustment Is Required

Remove the tie rod yoke bolt on the left side.

Loosen the adjusting yoke clamp screw.

Lengthen or shorten the tie rod by turning on or off the adjusting yoke.

Insert yoke bolt and measure (J).

Continue until the correct dimension $\frac{3}{8}$ to $\frac{1}{2}$ in. is obtained.

Tighten clamp screw.

The amount each front wheel "toes in" will be $\frac{3}{16}$ to $\frac{1}{4}$ in.

Front Wheels "Shimmy"

When the front wheels "shimmy" or wabble it is usually caused by the steering knuckle bolts not setting at the correct angle. The bolts should set slightly forward of a vertical position, at the bottom, in order to give the steering knuckle a slight caster effect. In Fig. 51 we have shown how to arrive at the proper adjustment.

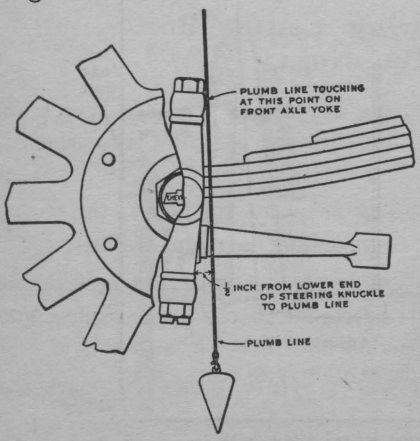


Fig. 51—Position of Steering Knuckle Bolt

With a weight attached to a cord, suspend it so that the cord will touch the upper part of the yoke on the front axle "I" beam. With the knuckle bolt at the proper angle, the distance between the bottom of the steering knuckle and the cord should be about $\frac{1}{2}$ inch. Measurements to be taken when the car contains usual load.

If the steering knuckle bolt is too far forward at the bottom, loosen the spring bolt clip and insert a tapered shim of hardwood or metal between

the spring and the axle "I" beam. This will tilt the "I" beam in the opposite direction.

Removing and Installing Steering Knuckle Bushing

A bushing puller as illustrated in figure 52 can be used to an advantage in removing steering knuckle bushings.

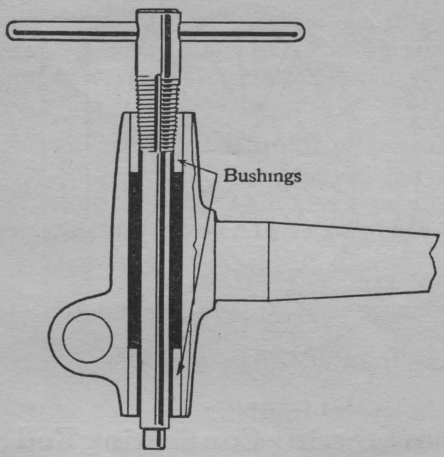


Fig. 52—Removing Steering Knuckle Bushing.

If a tool of this kind is not available, an ordinary course threaded tap of the proper size can be threaded into the bushing and with a bar whose outside diameter is slightly less than the diameter of the hole, and 1″ longer than the distance through the steering knuckle drive out the tap and bushing.

To install new bushing round their edges with a file. To press into place, do not hammer directly on the bushing, otherwise you will distort the metal causing trouble, but press into place with a vise or arbor press.

Installing Spring Center Bolt
Model Four-Ninety

Relieve the weight on the spring by placing the jack under the frame, near the spring bracket, and lift the car (not the wheels). (Fig. 53.)

In order for the spring bolt to seat properly, the hole in the spring bracket should be chamfered or countersunk to a $\frac{3}{16}$-in. radius.

When the hole in the bracket is in line with the hole in the spring, the bolt may be easily inserted and the lock washer and nut drawn up tightly.

While the car is raised spread graphite grease between the leaves of the springs.

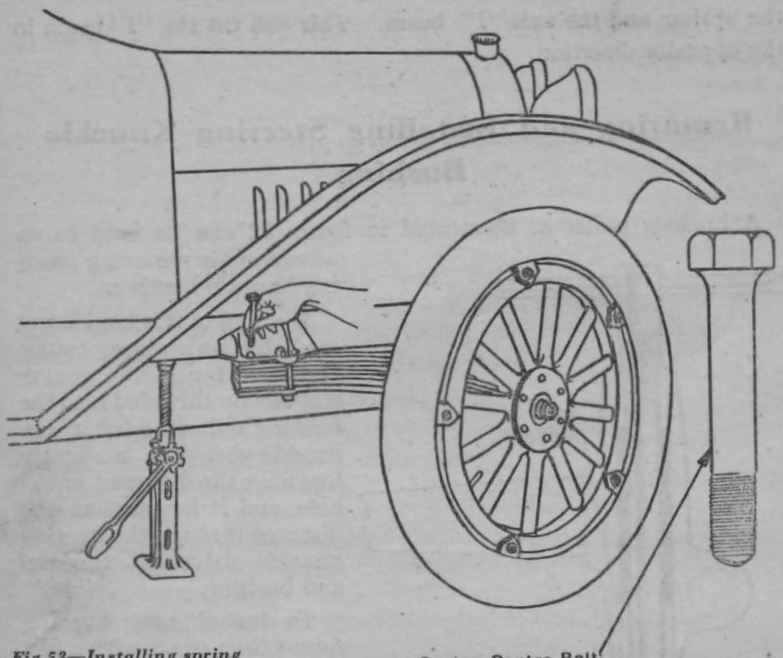


Fig.53—Installing spring Center bolt.

Taking Lost Motion from Steering Connecting Rod

Model Four-Ninety and "G"

Remove the cotter pin from one end of the steering connecting rod (Fig. 54).

Remove screw plug and spring.

Cleanse the rod end and parts with gasoline, pack with grease, and reinstall.

With a screwdriver, placed in the slot of the screw plug, turn in the direction of the hands of a clock, to force the spring and ball seat close to the steering pitman arm ball.

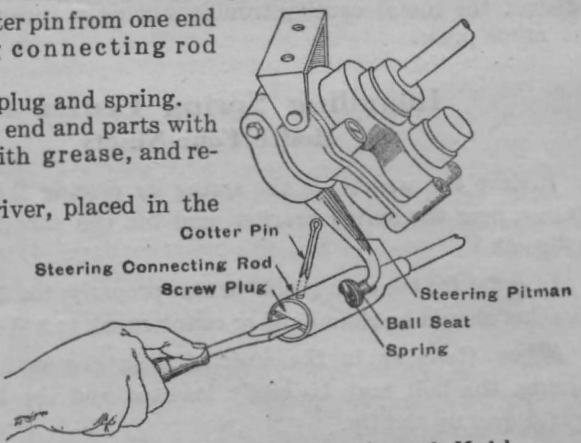


Fig. 54—Adjusting steering connecting rod, Model Four-Ninety, G

After all lost motion is removed lock the plug with the cotter pin.

To Eliminate the Vibration of Gears

Remove steering gear assembly.

Disassemble steering gear and install against the Welsh plug in steering gear case at the end of the steering gear main shaft, a coil spring $1\frac{1}{8}$ inches free length, $\frac{11}{16}$ of an inch in diameter requiring approximately 60 lbs. pressure to compress.

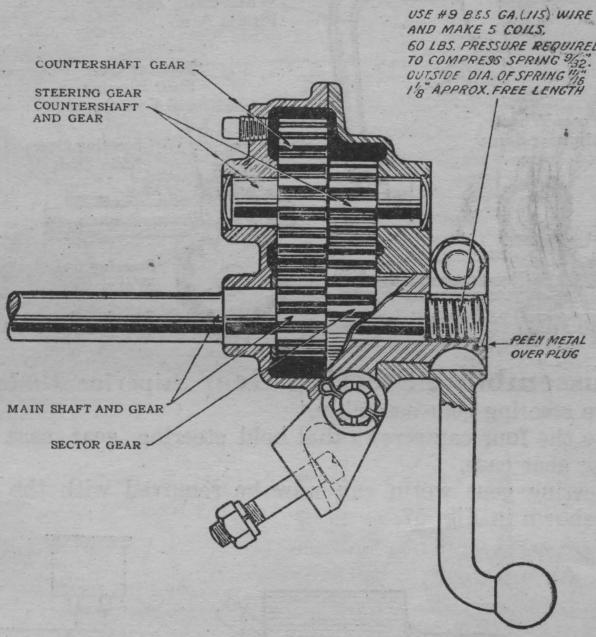


Fig 55—Steering Gear

Be sure to peen metal over Welsh plug.

Reassemble steering gear and install in car.

Adjustment of Steering Gear

Superior Model

To take up end play in the steering gear main shaft, loosen the worm adjusting screw lock nut. Screw down the worm adjusting screw until all play is removed without binding.

To adjust end play in the worm gear, tighten the worm gear adjusting screw.

Be sure that lock nuts are tight after the proper adjustment on both adjusting screws has been obtained.

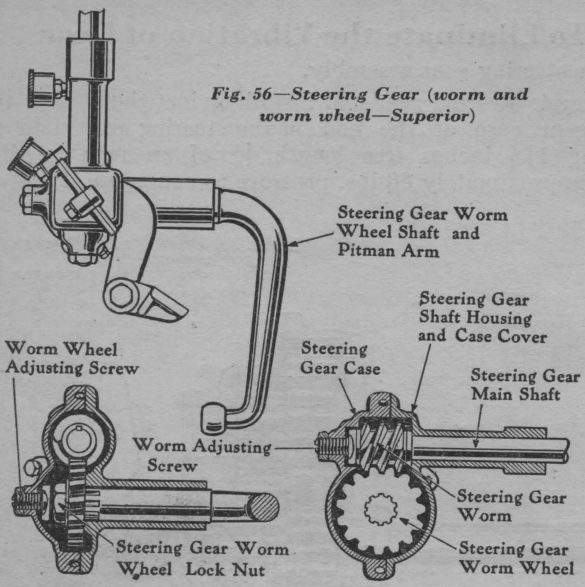


Fig. 56—Steering Gear (worm and worm wheel—Superior)

Disassembling Steering Gear Superior Model

Remove steering gear assembly.

Remove the four cap screws that hold steering gear case cover to steering gear case.

The steering gear worm can now be removed with the aid of puller as shown in Fig. 57.

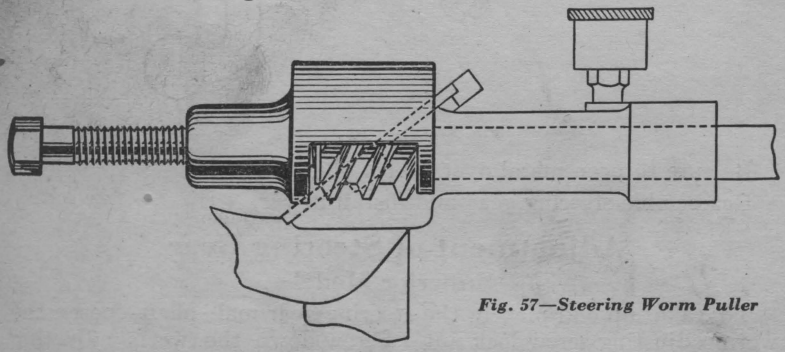


Fig. 57—Steering Worm Puller

If there is lost motion between the gears, the steering gear worm wheel can be removed and turned one half turn to furnish a new tooth bearing.

To remove the steering gear worm wheel remove nut that holds worm wheel on spline shaft and remove gear.

Adjustment of Steering Gear
Models FA, FB, and T

Raise the front end of the car until the front wheels clear the ground, as this will help determine whether the adjustment is correct.

To take up end play in the worm shaft, (Fig. 58), loosen the clamp screw.

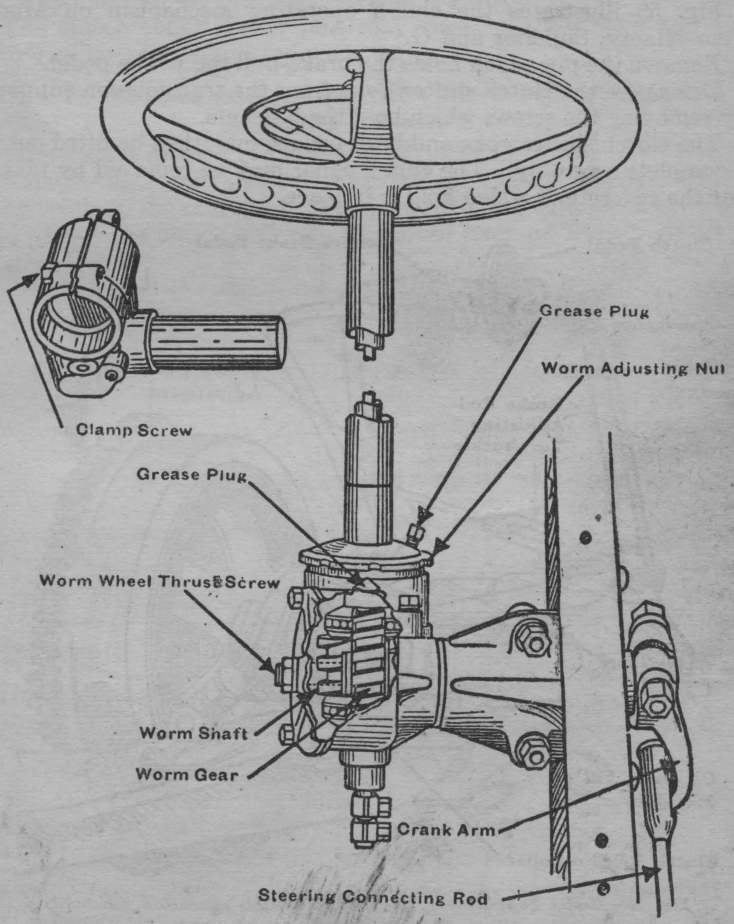


Fig. 58—Adjustment of steering gear—Models FA and FB.

Screw down (turn in the same direction as the hands of a clock,) the worm adjusting nut until all lost motion is removed without causing the steering wheel to bind when turned.

Tighten the clamp screw, after the proper adjustment is obtained.

To adjust the worm wheel for end play tighten the worm wheel thrust screw.

How to Remove and Install Clutch Collar

Models Four-Ninety, Superior and G

Fig. 59 illustrates the clutch operating mechanism on Model Four-Ninety, Superior and G.

Remove the pin which holds the brake-pull rod to the pedal.

Disengage the clutch shifter yoke from the transmission supports by removing the screws which hold the brackets.

The clutch shifter yoke and both pedals, may then be lifted out as a complete assembly. The clutch collar may be removed by taking out the two screws which hold it in place.

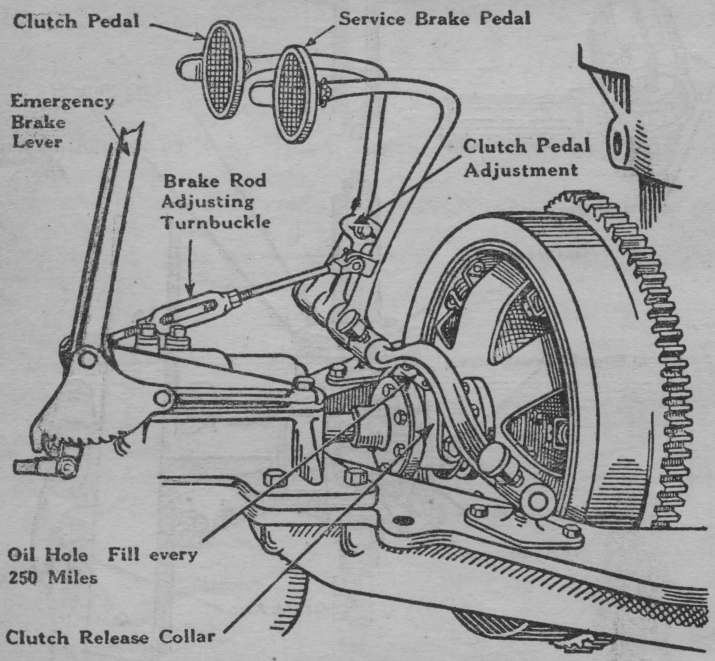


Fig. 59—Model Four-Ninety, Superior, G clutch operating mechanism

Rattling or clicking of the clutch collar when the motor is running and when no pressure is being applied to the clutch pedal, and which disappears when pressure is applied, can usually be attributed to the trunion screws not being adjusted properly. The trunion screws

should be adjusted so as to permit only a slight amount of clearance between the clutch collar and the shoulder on the trunion screws.

The lock nuts should be drawn tight to prevent the trunion screws from working loose.

How to Remove and Install Clutch Collar, Model FA

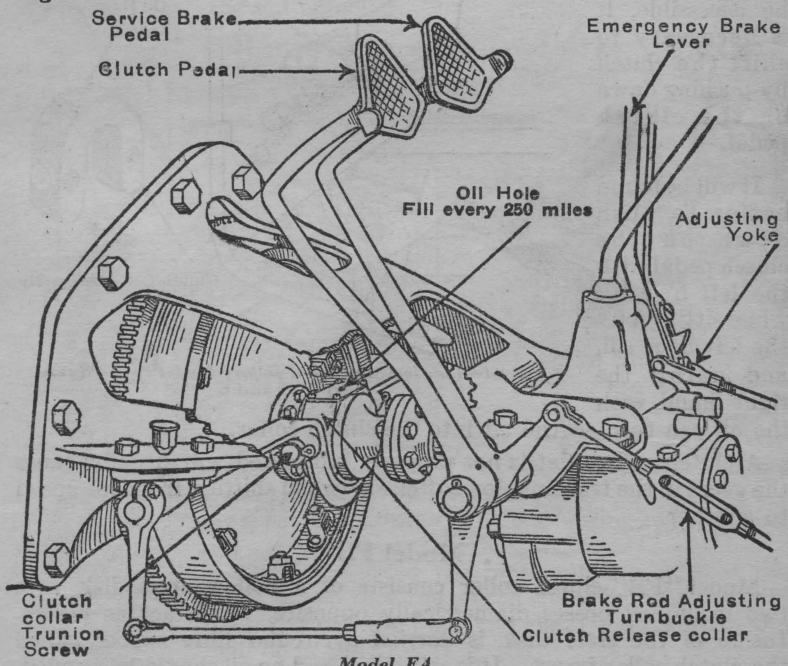
To remove the clutch collar on Model FA (Fig. 60) remove the cotter pins in each side of the clutch yoke which hold the clutch collar trunion screws into the clutch shifter yoke.

The clutch collar rocker pins may then be withdrawn and the clutch collar assembly lifted out.

How to Remove and Install the Clutch Collar Insert on Model FB and T

Remove the pressed metal pan from under the flywheel.

Remove the clamp screw which holds the two clutch collar equalizing levers to the shaft, and slide them off of the clutch collar. This will permit the clutch collar to be moved back on the clutch drive ring.



Model FA

Fig. 60—Clutch operating mechanism

With an ordinary penknife cut the clutch collar insert in half and remove from the collar and drive ring.

Upon securing the new fiber insert, either saw or cut it across the center and install each half around the clutch drive ring inside the clutch collar, just as the original one was installed.

The clutch collar equalizing levers may now be put in their proper places and clamped to the shaft.

This fiber spacer is self-lubricating, therefore no oil is necessary on the clutch collar.

Lubricating Clutch Collar

Models Four-Ninety, Superior and G

The clutch collar consists of a hollow bronze casting. In its friction surfaces wood plugs are inserted extending into an oil receptacle formed by the hollow casting; through these plugs the oil exudes (or sweats) and lubricates the friction surfaces.

Fig. 61 illustrates the proper method to pursue in oiling the clutch collar. In order that the oil hole, which is in the top cover of the clutch collar, may be accessible, it is necessary to shift the clutch by pushing down on the clutch pedal.

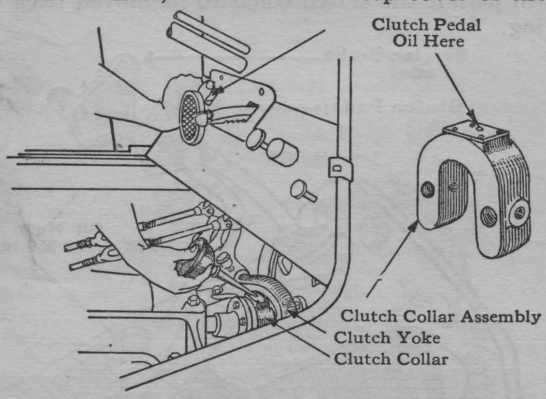


Fig. 61—Lubricating clutch collar, Model Four-Ninety, Superior and G

It will be found easier to push down on the clutch pedal with the left hand, while sitting on the left door sill, and using the right hand with the oil can to inject the oil into the clutch collar.

A clutch collar that is not properly lubricated will usually cause the gears in the transmission to "clash" when shifting from one speed to another.

Model FB

Model "FB" clutch collar consists of a hollow steel disk with two machined bosses diametrically opposite, which act as pivots. Inside of the steel disk is carried a circular fibre spacer, called the clutch collar insert. It is self-oiling and no oil should be applied.

It may happen that this fibre spacer will in time become thin. When this happens a new disk should be installed. This operation may be accomplished by referring to Page 69.

Model FA

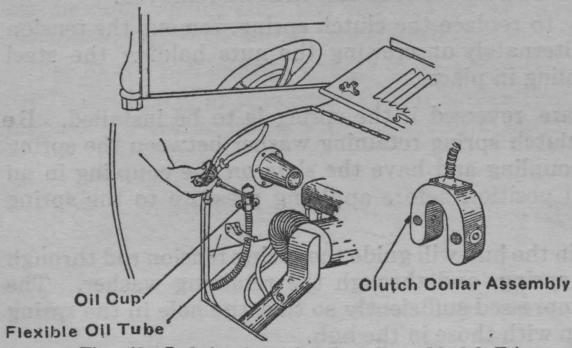


Fig. 62—Lubricating clutch collar, Model FA

The clutch collar should be oiled regularly, after having driven 250 miles.

On Model FA, Fig. 62 illustrates the method to pursue in oiling the clutch collar.

Raise the hood on the right side. Mounted upon the dash will be found a small oil cup which has a spring cap. By lifting this spring cap and injecting the oil into the cup, it will flow down to the clutch collar.

Removing and Installing Clutch
Models Four-Ninety, Superior, G and FA

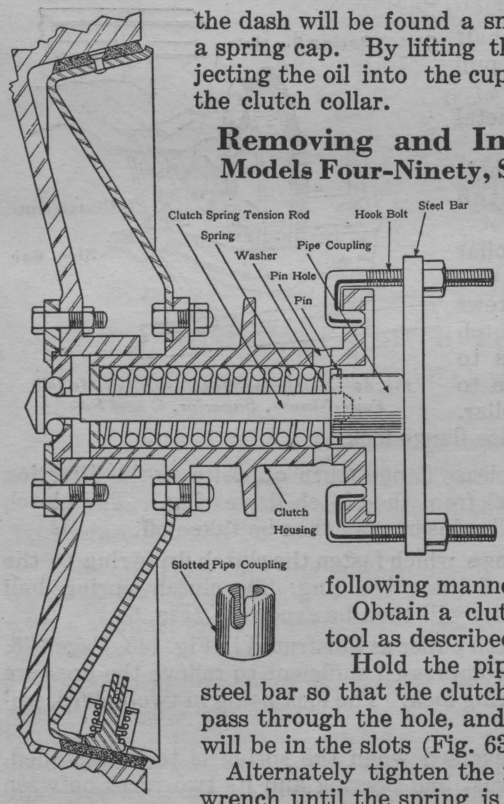


Fig. 63—Clutch—Models Four-Ninety, Superior, G and FA

To remove the clutch proceed as follows:

Remove propeller shaft assembly.

Remove the transmission and clutch shifter yoke. (See Page 77 covering removal of transmission.)

The clutch hub and spring are now accessible.

The clutch spring may be removed in the following manner.

Obtain a clutch spring compressing tool as described in Fig. 142.

Hold the pipe coupling between the steel bar so that the clutch spring tension rod will pass through the hole, and the clutch spring pin will be in the slots (Fig. 63).

Alternately tighten the nuts on the bolts with a wrench until the spring is compressed sufficiently to permit the pin to be driven out with a round punch through the holes in the clutch hub (Fig. 63).

The clutch hub and clutch cone can then be removed.

If it is necessary to replace the clutch spring, remove the tension of the spring by alternately unscrewing the nuts holding the steel bar and pipe coupling in place.

The operations are reversed if the spring is to be installed. Be sure to place the clutch spring retaining washer between the spring and slotted pipe coupling and have the slots on the coupling in an upright or vertical position before applying pressure to the spring (Fig. 63)

The spring seat in the hub will guide the spring tension rod through the center of the spring, and through the retaining washer. The spring must be compressed sufficiently so that the hole in the spring tension rod lines up with those in the hub.

Models FB and T

Remove the propeller shaft housing assembly, brake pull rods and transmission.

Remove the pressed metal pan under the fly wheel.

Remove the hand hole cover on top of clutch housing.

Remove both clutch collar equalizer springs. (Fig. 68.)

Remove clamp screws holding the two clutch collar equalizing levers to the shaft and slide them to the sides, free from the collar.

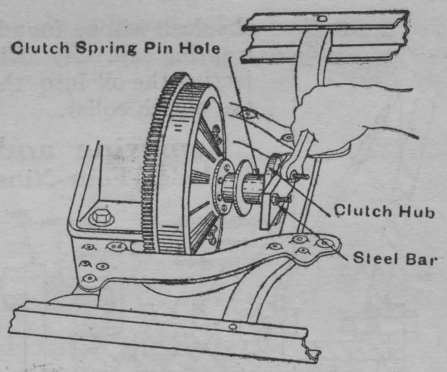


Fig. 64—Removing clutch spring—Models Four-Ninety, Superior, G and FA

Remove clutch release flange lock.

Unscrew the clutch release flange (turn opposite to the direction of the hands of a clock) from the clutch drive ring. The clutch collar and the clutch collar insert may then be taken off.

Remove the six screws which fasten the clutch drive ring to the clutch hub, and take off the drive ring. The clutch spring ball bearing and locking device will then be exposed. (Fig. 68.)

With the use of a clutch puller as illustrated in Fig. 143, Page 175, the clutch spring can be compressed sufficient to relieve the pressure from the thrust ball bearing lock. The lock being in two halves, will fall out of place.

The operations are reversed when the spring is to be installed. Be sure to place the thrust ball bearing and its two races between the spring and flat surface of the clutch puller. Compress the spring sufficiently to permit the thrust bearing lock to be installed, which

can be put in place after the hub and spring have been guided over the clutch pilot and thrust tension rod.

The clutch bell housing should never be removed unless it is absolutely necessary, as it is through this source that the perfect alignment of the transmission with the motor is obtained.

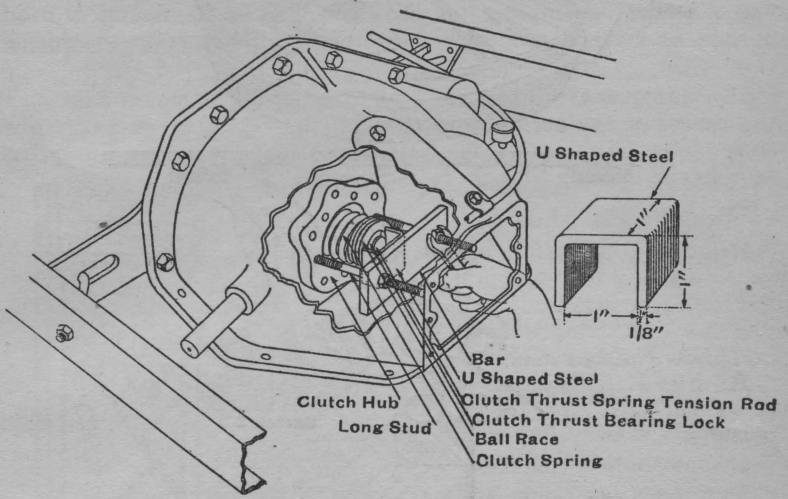


Fig. 65—Removing clutch spring—Models FB and T

Installing Clutch Leather

Fig. 66 illustrates the best method for installing the clutch leather on the cone.

Soak the clutch leather in water for a short time so that it will stretch slightly.

Place the leather so that the smaller diameter lies upon a perfectly flat surface (Sketch I).

Guide the cone into the leather evenly all around and press it down as far as possible with the hand, then tap the cone lightly with a hammer around its circumference until it is completely inside the leather.

Punch or drill holes in the leather corresponding to those in the face of the cone, and insert rivets, Sketch 2. Sink the heads below the surface of the leather by holding the divided prongs of the split rivet, which passes through the clutch cone, over a chisel, and hitting the rivet head with a ball-headed hammer or with a drill the size of the rivet head countersink the clutch leather sufficient to permit the rivet to drop below the surface of the clutch facing.

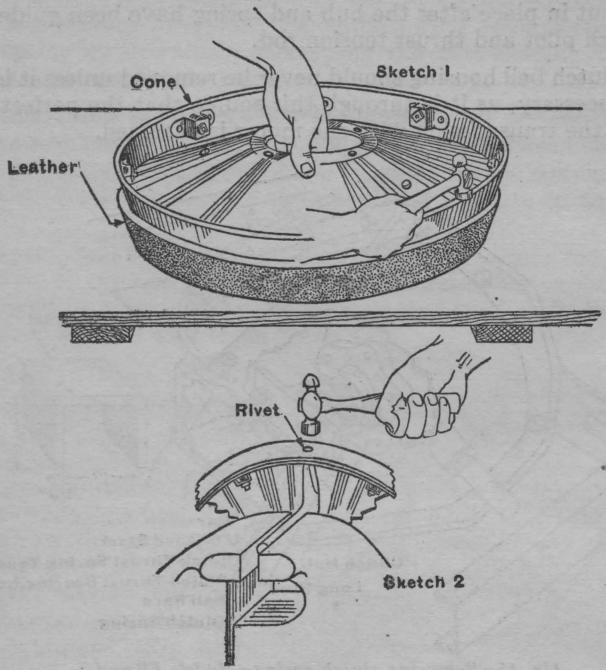


Fig. 66—Installing clutch leather

Adjustment of Clutch

On the Models Four-Ninety, Superior, G, are six clutch leather expanders, while on the Models FA, FB, and T there are ten. These expanders are placed under the clutch leather (Fig. 67) and present a slightly raised point of contact. Their function is to prevent the clutch from "grabbing," or taking hold too quickly, thus causing the car to start with a jerk. If this condition exists, the expanders should be adjusted.

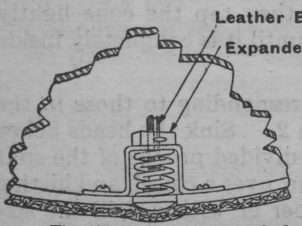


Fig. 67—Adjustment of clutch

To adjust the expanders, turn each of the expander nuts from the right to left until a thickness gauge about .005 of an inch in thickness can be placed between the nut and clip.

In the event the clutch is "slipping" or will not hold when engaged, turn each expander nut from the left to right until they lightly touch the clip, then give them one-half turn in the opposite direction.

Unscrewing a half turn allows the expanders to act properly under the clutch.

Care should be exercised when adjusting the clutch to obtain the same adjustment on all the clutch expanders as an improper adjustment will cause the clutch not to engage evenly in the fly wheel and burn in certain spots; also producing a "squeak" or rasping noise" when being engaged.

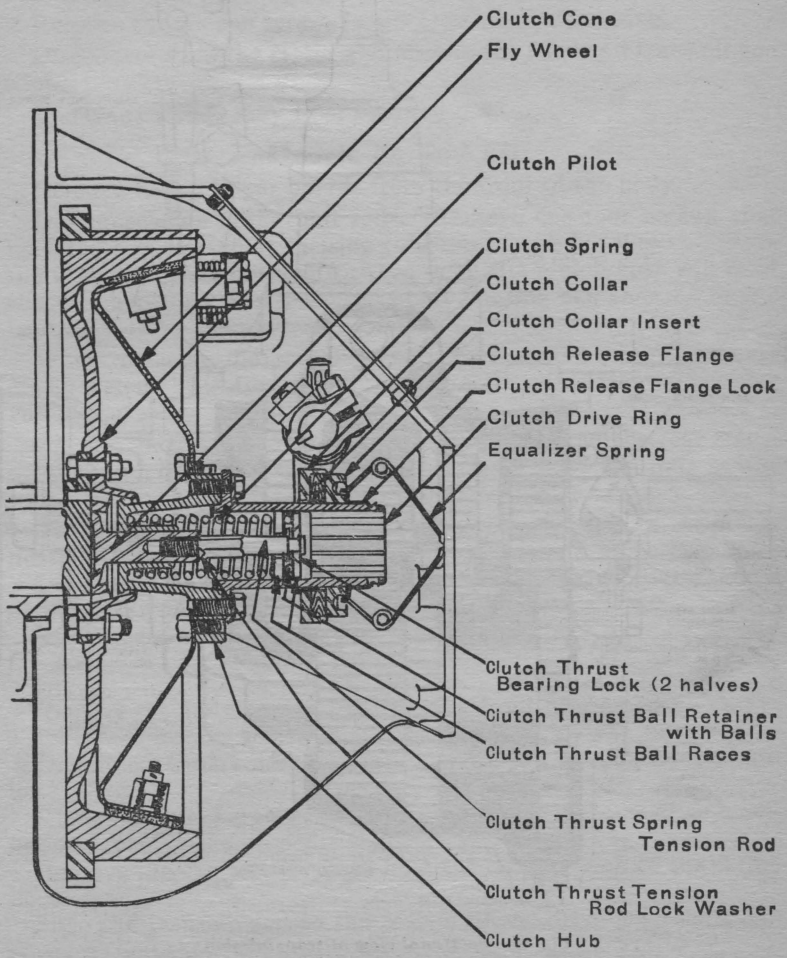


Fig. 68—Clutch—Models FB, T

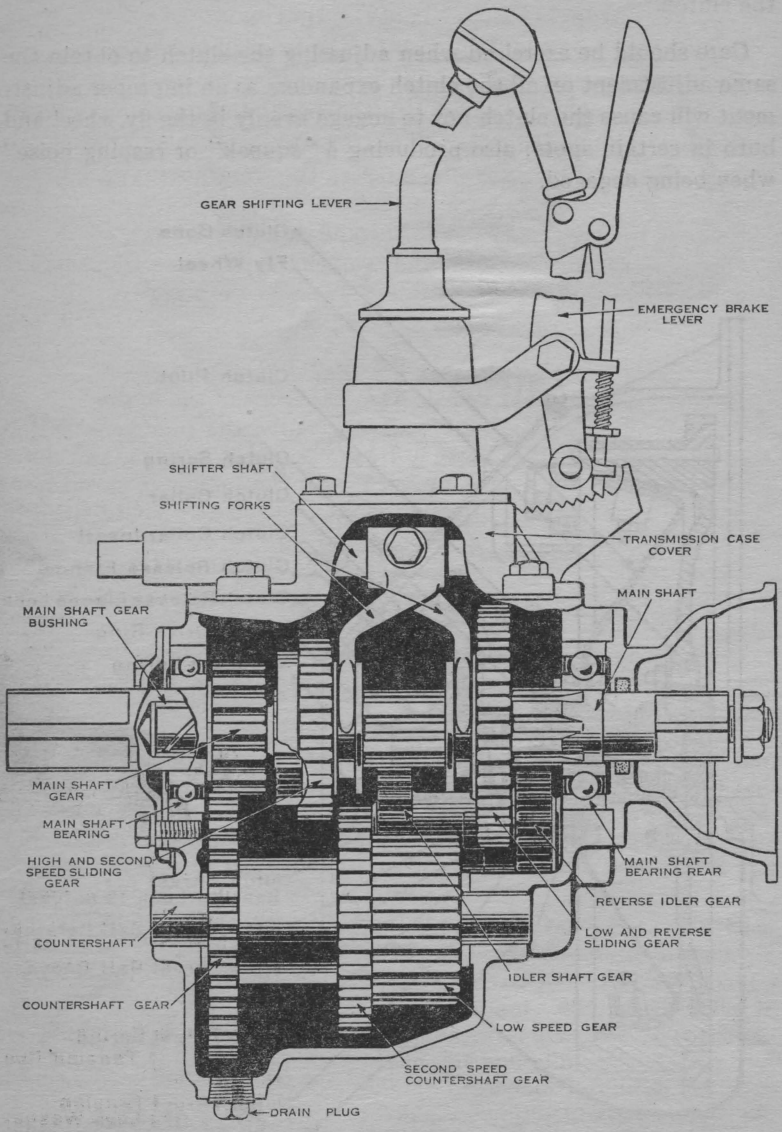


Fig. 69—Sectional view of transmission
All Models

Removing Transmission

Models Four-Ninety, Superior and G

Remove toe and floor boards from the front of the body.

Remove propeller shaft assembly.

Disconnect the brake rods from the pedal and hand brake lever.

Remove the two bolts from the left hand pedal shaft bracket.

Remove the four screws which fasten the transmission case to the supports.

Remove the six cap screws in the clutch hub drive ring.

Disconnect from the motor and remove the left hand transmission support.

The transmission may then be lifted out.

Models FA and FB

Remove toe and floor boards from the front of the body.

Disconnect the brake pull rods. Remove the four screws that hold the propeller shaft housing to the rear axle housing and move the propeller shaft housing forward until the pinion gear will clear the axle housing. The propeller shaft housing can then be drawn backward from the universal joint ball.

When replacing the propeller shaft housing, the original number of shims must be put back to insure the same adjustment of the ring and pinion gears.

On the model FA remove the bolts which hold the rear transmission support cross member to the frame; also the four screws which fasten the transmission to the transmission support.

On the model FB remove the four screws which hold the transmission to the clutch housing.

Slide the transmission to the rear until the drive gear shaft is disengaged from the clutch drive ring.

The transmission may then be lifted out.

Model T

Remove toe and floor boards from the front of the body.

Disconnect brake rod from emergency brake lever.

Disconnect the front and center universal joints from the companion flanges.

Disconnect the propeller shaft bearing from the frame cross member and remove the propeller shaft.

Remove the cap screws which hold the transmission to the clutch housing.

Slide the transmission to the rear until the drive gear shaft disengages from the clutch drive ring.

The transmission may then be lifted out.

Disassembling Transmission

Models Four-Ninety, Superior, FA, G, FB and T

Remove the transmission assembly and universal joint.

Remove main shaft gear bearing cap (Fig. 69) forward end.

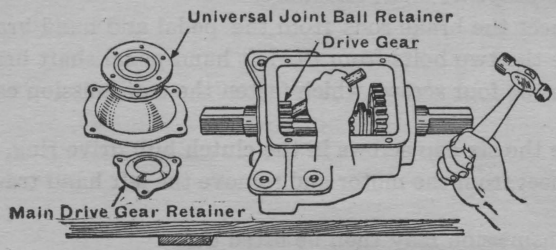


Fig. 70 —Disassembling transmission

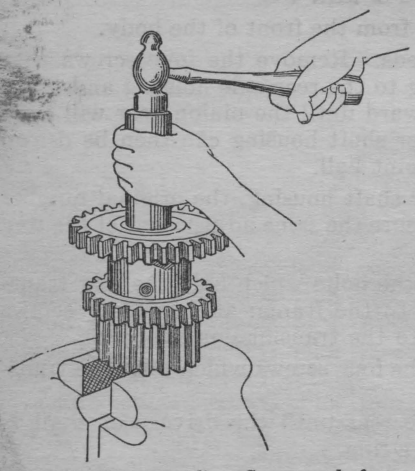


Fig. 71—Disassembling Counter shaft.

Remove the universal joint ball retainer (Fig. 70) rear end.

The main shaft and ball bearing may be easily removed by placing a bar of soft metal or a block of wood inside the transmission case against the clutch gear, and delivering several sharp blows with a hammer (Fig. 70).

The spline shaft may then be driven out through the forward end.

Remove the high and in-

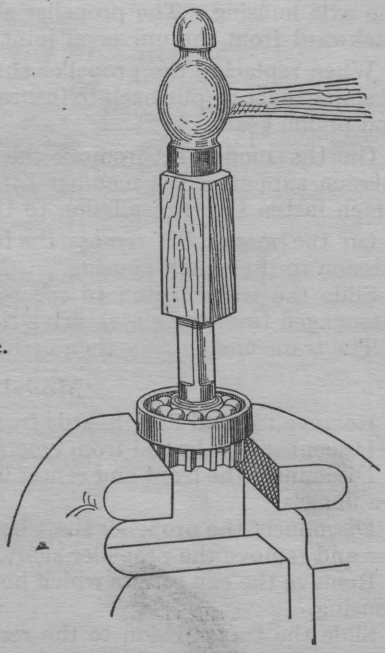


Fig. 72—Removing Bearing from main shaft clutch gear.

termediate sliding gears.

Remove the cotter pin holding the countershaft and drive the shaft out through the rear end of the housing.

Pick out the countershaft gears (Figs. 71 and 72).

Remove the pin holding reverse idler gear shaft and drive the shaft out through the rear end of the housing.

Removing Bearing from Main Shaft Drive Gear

Place the main shaft drive gear in a vise with the outer ring of the bearing resting on the top of the jaws (Fig. 72).

With a block of wood held against the end of the shaft, strike several sharp blows until the bearing is released.

Disassembling the Countershaft

Open the jaws of a vise wide enough so that the countershaft sleeve will pass through.

Drive out the sleeve and four round keys with a soft bar and a hammer (Fig. 71).

Time can be saved by the use of an arbor press in removing the transmission gears and bearings from the shafts.

Disalignment of Transmission

To determine if the transmission is out of alignment, remove the six cap screws which connect the clutch hub drive ring to the clutch hub and separate the drive ring from the clutch hub.

For a perfect alignment, the clutch hub drive ring should slide into the flange in the clutch hub without any resistance.

If, upon making this test, the transmission is found to be too low, proceed as follows:

Loosen the hex head cap screw that holds the transmission wishbone support brace to the cylinder block and place under the brace sufficient shims to bring it to the proper height.

If the test proves that the transmission is higher than the motor, loosen the two cap screws which hold the wishbone support brace to the transmission supports and place shims between the wishbone support brace and the transmission supports.

All bolts which hold the transmission and motor in place must be kept tight at all times to prevent disalignment.

Removing the Universal Joint

Models Four-Ninety, Superior, G, FA, and FB

Remove the propeller shaft housing assembly.

Separate the joint ball collar from the ball socket (Fig. 74) by removing the clamp bolts.

Separate the universal joint rings (Fig. 74) by removing the bolts. The rear yoke can then be removed.

Unscrew the nut holding the forward yoke to the transmission spline shaft.

Holding a bar of soft metal or wood against the threaded end of the transmission shaft, hit it several sharp blows with a hammer (Sketch 1, Fig. 73). Usually, this is all that is necessary to loosen the yoke.

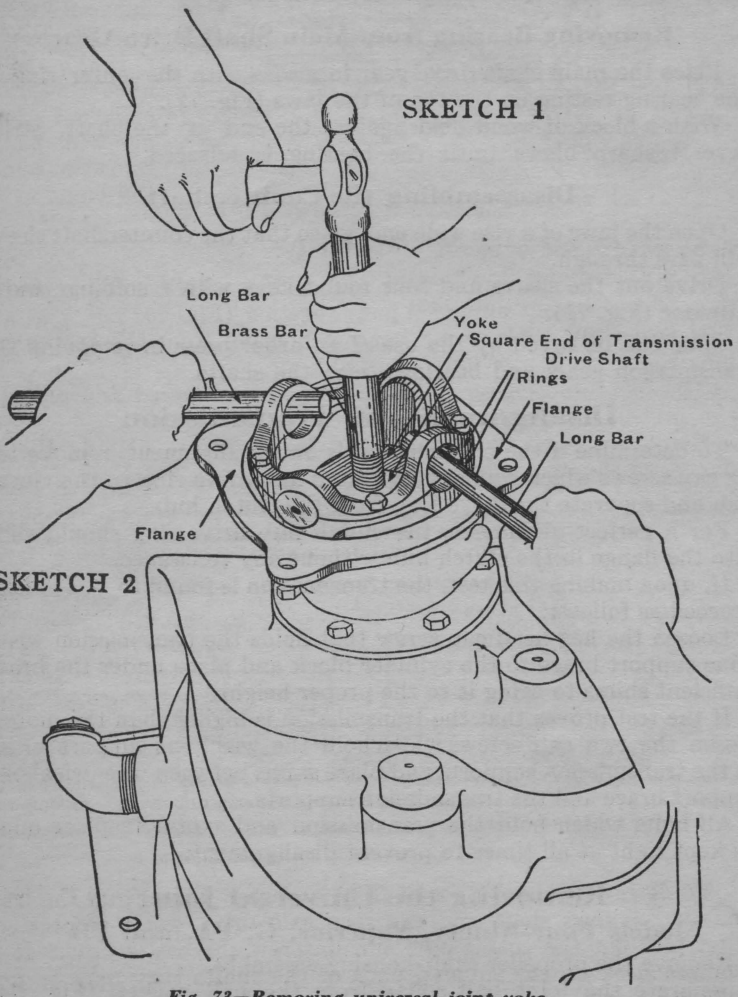


Fig. 73—Removing universal joint yoke

If the yoke cannot be removed by this method, reinstall the outside ring and with two long metal bars placed in the opposite

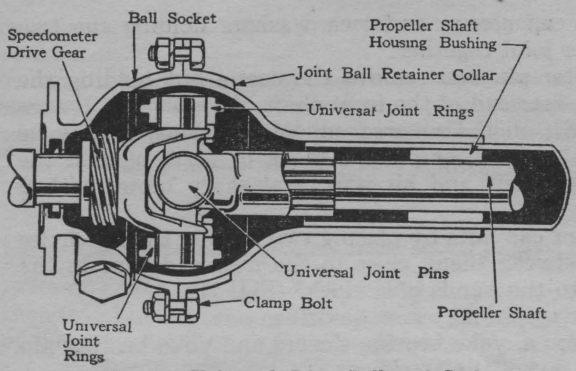


Fig. 74—Universal Joint Ball and Socket

holes of the joint rings force off the yoke from the squared shaft by pressing the bars down against the flange (Sketch 2, Fig. 73).

If the bars are about 18 in. long, sufficient leverage will be obtained to remove the yoke.

Model T

Remove the six cap screws and lock washers holding the two flanges of the front universal joint together (Fig. 75)

Remove the self-aligning bearing housing from the center cross member at the center universal joint.

The front and center joints may then be lowered and pulled off the splined shaft of the rear joint.

Remove the six cap screws and lock washers holding the two flanges of the rear joint together.

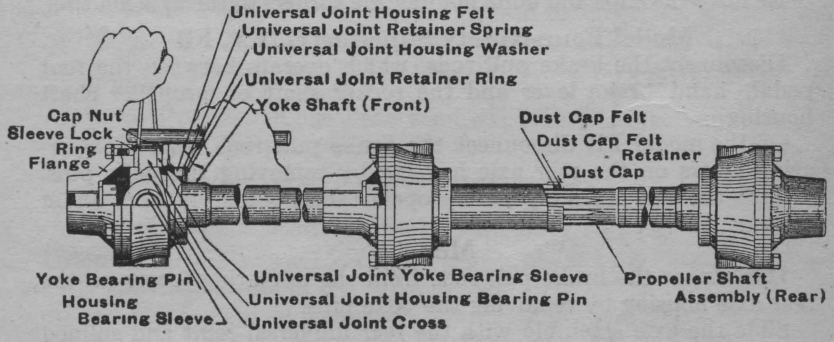


Fig. 75—Model T, Universal Joint

To disengage the flanges of front and rear joints from the transmission splined shaft and the rear axle drive worm respectively, first pull out the cotter pins and unscrew the castle nuts. If the flanges stick on the squared ends of the shafts they may be pried off with a cold chisel or some other suitable tool. The front and rear flanges need not be removed if only the joints are to be taken off the chassis.

Remove the six cap screws and lock washers holding the two flanges of the center joint together.

Pull out the cotter pin and remove the castle nut holding the center flange to the rear end of the front shaft.

If the flange sticks on the squared end of the shaft, it may be pried off with a cold chisel, or place a block of wood against the threaded end of the shaft and hit it several sharp blows with a hammer.

Remove both joint cap nuts by placing two nails in the two holes and insert a bar between them, close to the nut, and turn in the opposite direction to the hands of a clock. (Fig. 75).

The housing bearing pin may now be driven out.

The yoke shaft, cross, yoke bearing sleeves and yoke bearing pin may now be pulled out of the housing.

If on account of wear it becomes necessary to install new housing bearing sleeves, remove the old ones by first taking out the lock rings which hold them in position. A chisel or center punch may be used for this purpose.

When assembling the joints pack each one with a good grade of grease before fastening the companion flanges together.

Removing the Rear Axle Assembly

Place a jack under each of the rear spring frame brackets, or with a chain hoist, raise the rear end of the car high enough to take the weight off the springs.

Remove the clips and bolts holding the springs to the axle housing.

Model Four-Ninety Superior, G, FA, FB

Disconnect the brake pull rods, which operate between the foot pedal, hand brake lever and the rocker shaft on propeller shaft housing.

On the model FB disconnect the brake pull rods from the operating levers on the rear axle housing by removing the yoke pins.

Slide the axle assembly with propeller shaft assembly from under the car.

Model T

Disconnect the brake pull rods from the operating levers on the rear axle housing by removing the yoke pins.

Slide the axle assembly with the rear universal joint and splined shaft from under the car.

Disassembling Rear Axle

Models Four-Ninety (with Straight Tooth Ring and Pinion Gears) FA

Removing Propeller Shaft Assembly

Slide the axle assembly from under the car.

Remove the four bolts which clamp the propeller shaft housing to the rear axle housings, and lift off. (See Page 83).

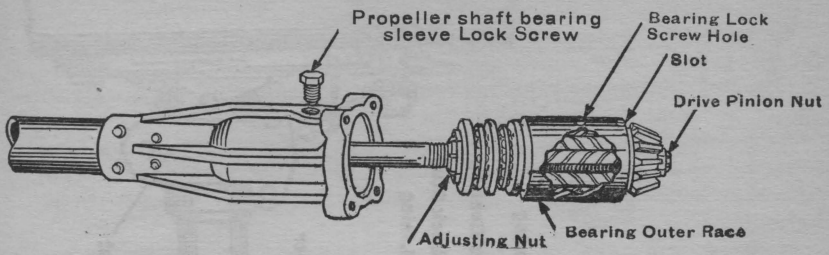


Fig. 76—Removing propeller shaft, Models Four-Ninety, FA

Remove the propeller shaft bearing lock screw (Fig. 76) and with the assembly held in a vertical position, let it drop so the spline end of the propeler shaft will strike on a wooden block or wooden floor.

Care should be exercised so that the splined end of the shaft is not battered or damaged in any way. If a few smart blows will not loosen the bearing, examine the housing carefully. It may have become battered and a small burr prevents the bearing sleeve from sliding out easily.

Removing Drive Pinion

Remove the cotter pin through the drive pinion nut and remove the nut by unscrewing.

Clamp the propeller shaft in a vise and tighten the propeller shaft adjusting nut against the propeller shaft thrust bearings.

This will usually be sufficient to loosen the drive pinion; however, should it stick, a few smart blows with a lead hammer, or, a block of wood against the threaded end of the shaft will bring it off.

Care should be exercised not to damage or batter the threads on the end of the propeller shaft.

After the drive pinion has been removed, the bearings can then be removed from the propeller shaft.

Replacing Drive Pinions

Models Four-Ninety, Superior, FA, FB

Examine the pinion gear key. See that it fits the slot in the shaft snugly, also that its edges are not rounded.

Spread a thin coat of Prussian Blue on the tapered hole of the pinion.

Slip the gear on the shaft and draw up the drive pinion nut.

Remove the pinion and note how the gear fits the shaft. This can be determined by the blue marks left on the shaft. If the bearing was even, the blue will be transferred to the shaft evenly.

Should the gear not fit the shaft evenly, remove the key, and, after smearing a little valve-grinding compound in the hole of the gear, slip it back on the shaft and rotate several times.

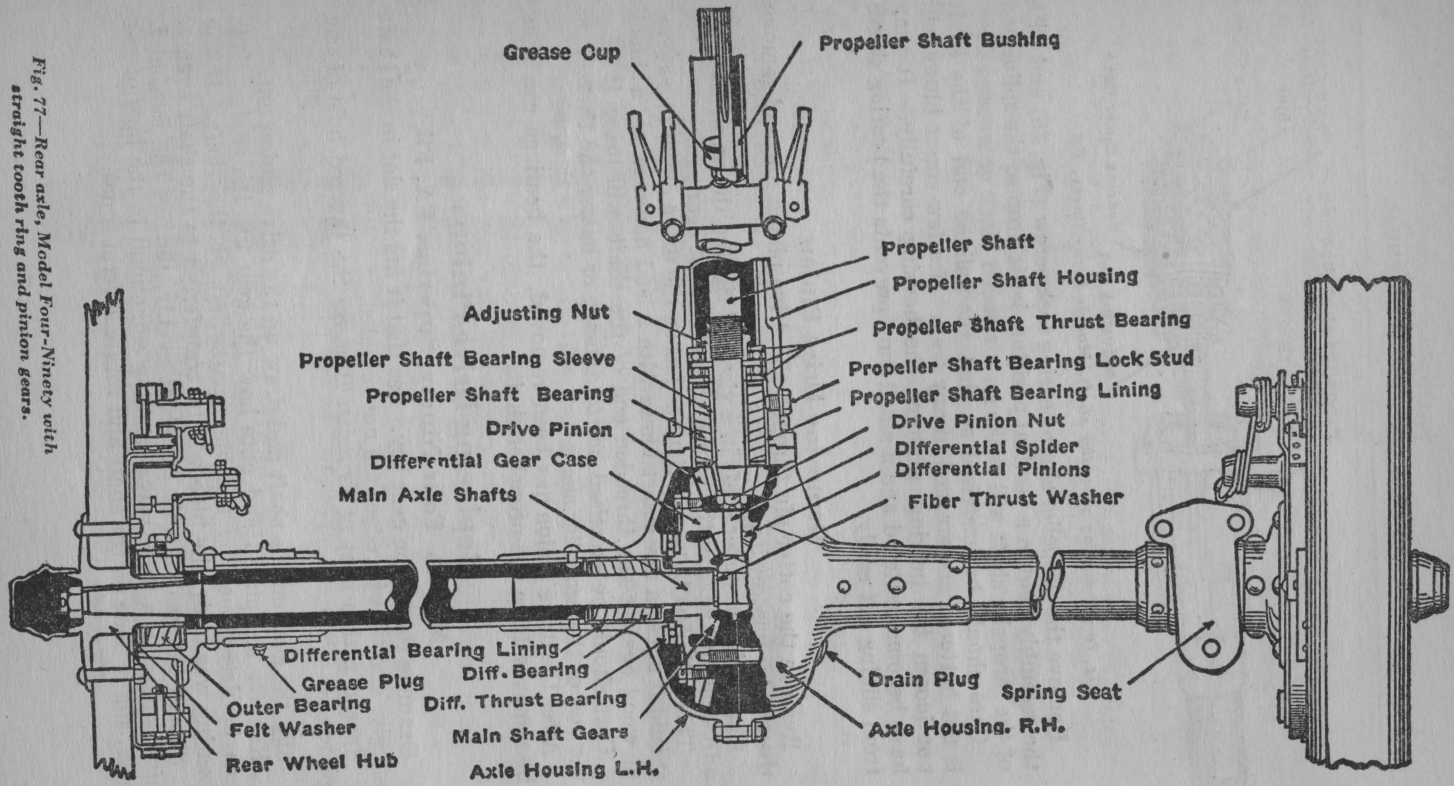


Fig. 77—Rear axle, Model Four-Ninety with straight tooth ring and pinion gears.

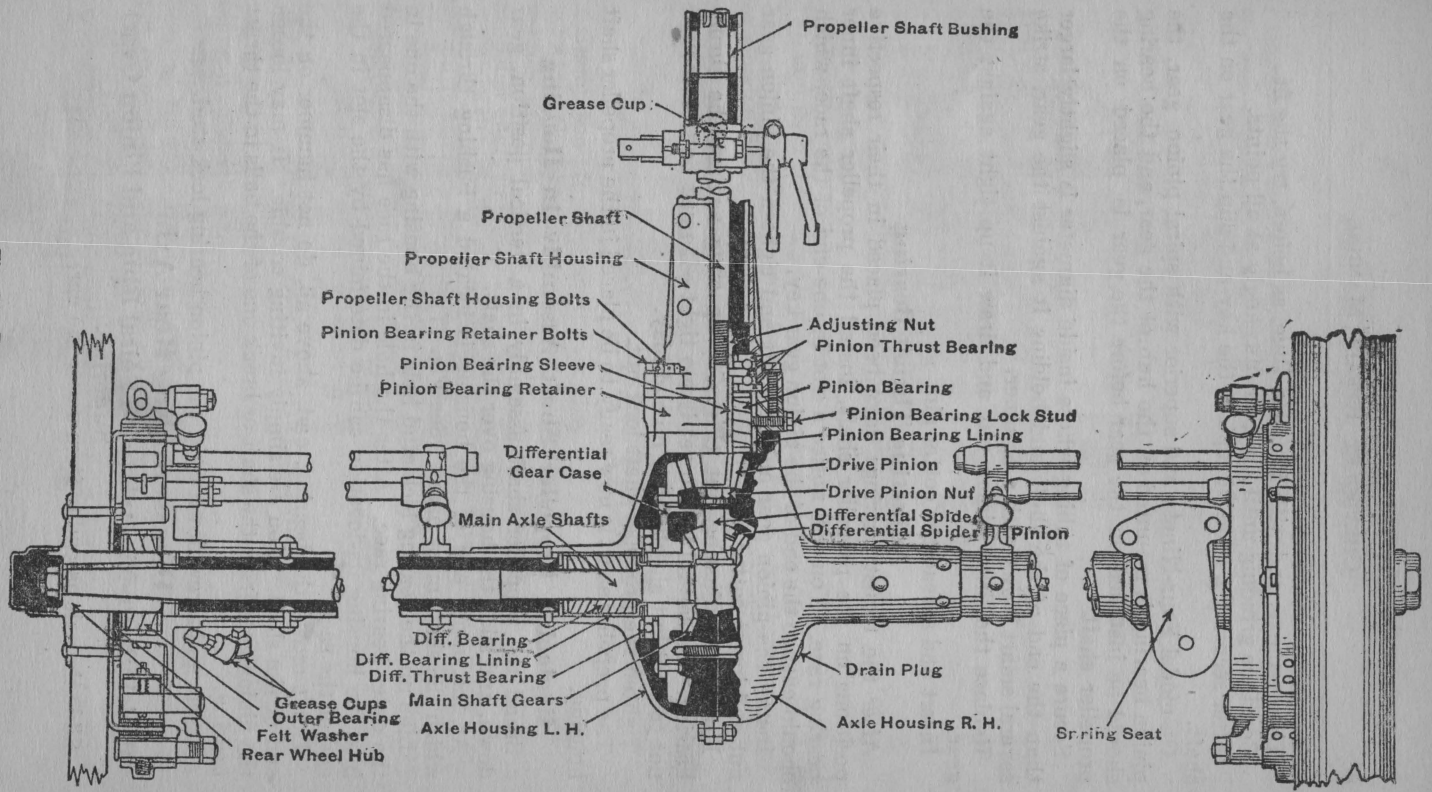


Fig. 78—Rear axle, Model FA

Then remove, and with Prussian Blue, as before, try the fit.

Continue grinding until the gear fits snugly at all points.

After securing a good fit replace the key and slip the gear on the shaft.

On model Four-Ninety and superior with spiral pinion gear, the pinion bearing is mounted on the hub of the gear, and the bearing should be installed on the gear before the gear is placed on the propeller shaft.

Secure a piece of tubing whose inside diameter is slightly larger than the end of the shaft and holding it against the gear, strike several smart blows with a hammer.

Replace the drive pinion nut and draw it up tight against the gear.

Insert and spread the cotter pin.

Adjusting Thrust Bearing

After the thrust bearings have been placed in their respective positions on the propeller shaft, install the propeller shaft inner bearing race. You will notice a slot in one end of the race, which should engage the end of the pinion gear key.

Install the pinion gear on the shaft and tighten the pinion gear nut and insert cotter pin.

Draw the adjusting nut (Fig. 76) up snug against the thrust bearing. Be careful not to get it too tight—it must be free enough not to bind but should have no end play.

Tighten the propeller shaft lock nut.

The propeller shaft is now ready to be placed in the propeller shaft housing.

Replacing Propeller Shaft Assembly in Housing

Stand the propeller shaft assembly in a vertical position, gear down, and slide the housing over the shaft.

At the upper end of the housing is located a bushing through which the shaft must pass. (See Fig. 77)

Line up the bearing lock stud hole in the housing with the one in the outer bearing race. After the hole in the race has disappeared into the housing its location can be determined by the slot in the end of the race.

Don't crowd the bearing, and, above all, do not hammer on the end of the shaft. You are simply inviting trouble. It may loosen the pinion gear from the shaft or break one of the balls in the thrust bearing.

Insert and screw down tight the pinion bearing lock stud.

Disassembling Rear Axle

Model "Four-Ninety" (with Spiral Ring and Pinion Gear) Superior.

Slide the axle assembly from under the car.

Remove the four bolts which clamp the propeller shaft housing to the rear axle housings and lift off. (See Fig. 80).

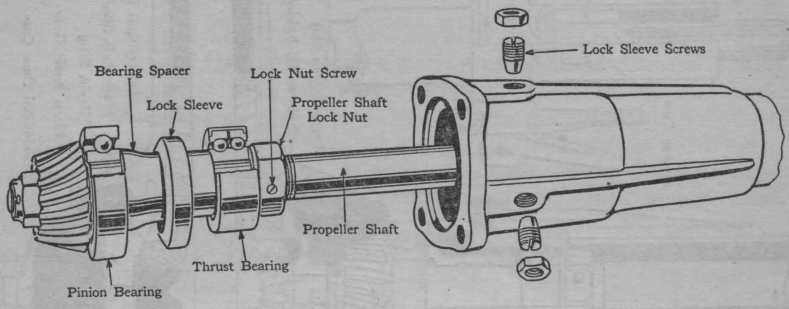


Fig. 79—Removing Propeller Shaft, Model Four-Ninety (with Spiral Gears) and Superior.

Remove the three propeller shaft bearing sleeve lock screws (Fig. 79), and with the assembly held in a vertical position, let it drop so the spline end of the propeller shaft will strike on a wooden block or wooden floor.

Care should be exercised so that the splined end of the shaft is not battered or damaged in any way.

Removing Drive Pinion

Clamp the propeller shaft in a vise.

Loosen the propeller shaft lock nut screw.

Push the pinion gear off by tightening the lock nut against the propeller shaft bearing.

This will usually be sufficient to remove the pinion; however, should it stick, a few smart blows with a lead hammer, or with a block of wood against the threaded end of the shaft will loosen the pinion gear so it can be removed.

After the drive pinion and pinion bearing have been removed, the thrust bearing can be removed from the propeller shaft.

Adjusting Thrust Bearing

After the thrust bearing has been placed on the shaft, install the pinion gear with pinion bearing.

Draw the propeller shaft lock nut (Fig. 79) up snug against the bearing. Be careful not to get it too tight—it must be free enough not to bind but should have no end play.

The propeller shaft can now be installed in the housing.

Stand the propeller shaft assembly in a vertical position, gear down, and slide the housing over the shaft.

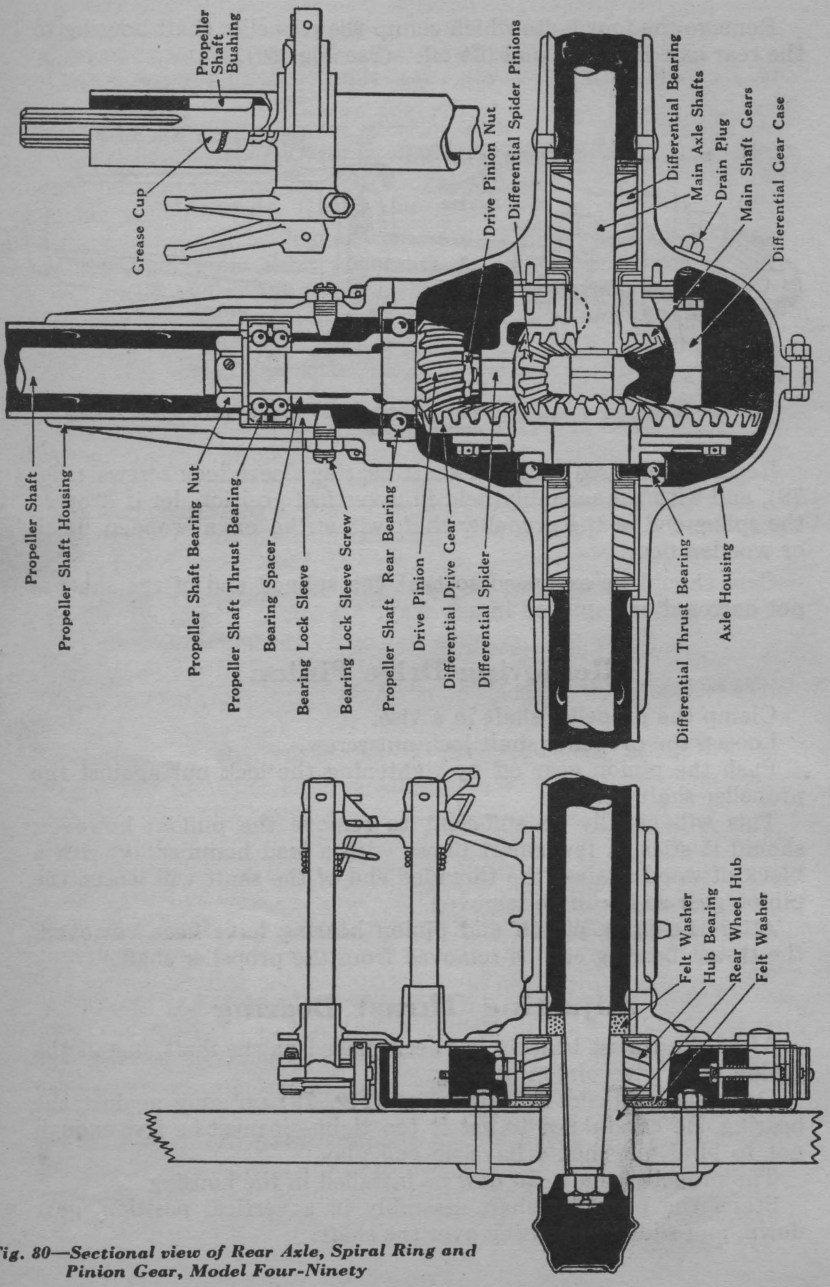


Fig. 80—Sectional view of Rear Axle, Spiral Ring and Pinion Gear, Model Four-Ninety

At the upper end of the housing is located a bushing through which the shaft must pass. (See Fig. 80)

Place the propeller shaft lock sleeve against the thrust bearing.

Insert and screw down tight, the three propeller shaft bearing sleeve lock screws and tighten the lock nuts.

Disassembling Rear Axle
Model "FB"
Removing the Propeller Shaft Assembly

Slide the axle assembly from under the car.

Remove the four propeller shaft housing bolts, clamping the housing to the axle housing and lift the assembly off. (Fig. 82).

Remove the hand hole plate.

Clamp the housing in a vise with the hand hole on top.

Remove the thrust bearing adjusting cage lock bolt.

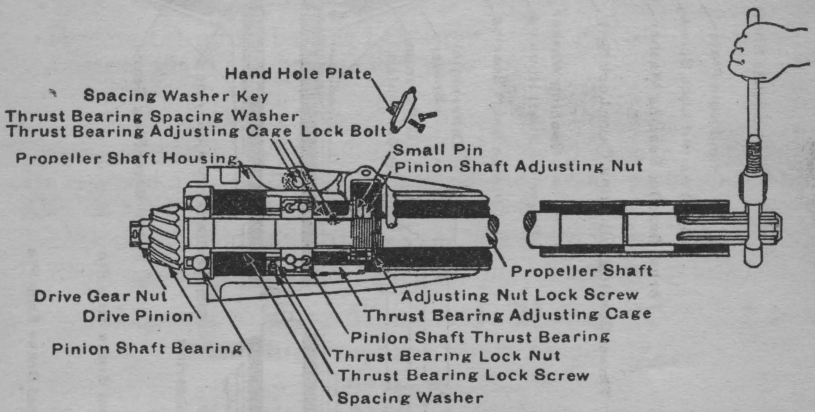


Fig. 81—Propeller Shaft Model FB.

Turn the propeller shaft so that the hole in the pinion shaft adjusting nut is in line with the milled slots in the end of the thrust bearing adjusting cage.

Secure a small steel pin 5/16 in. in diameter, 1 in. long, and place it through the slots into the hole in the pinion shaft adjusting nut.

With a large adjustable wrench gripping the splined end of the propeller shaft, turn in the same direction as the hands of a clock.

This will cause the thrust bearing adjusting cage to turn with the propeller shaft. Continue to turn until the cage is free, permitting the entire assembly to be removed through the drive gear end of the housing.

Should there be any difficulty in unscrewing the cage, insert a large screw driver into the split clamp at the point where the thrust bearing adjusting cage lock bolt was removed, and open the jaws of the clamp slightly.

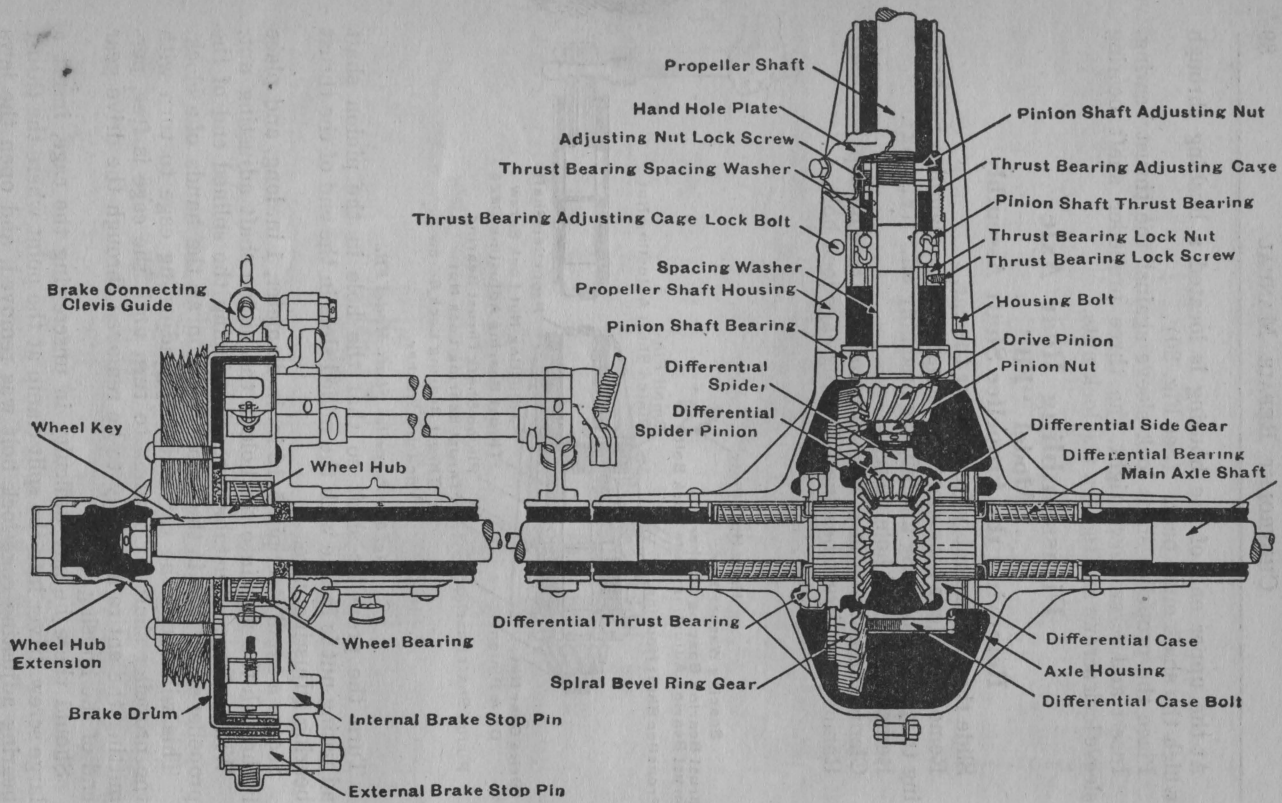


Fig. 82—Rear axle, Model FB

Removing Drive Pinion

Remove the small wire passing through the head of the adjusting nut lock screw. (Fig. 81.)

Remove the lock screw.

Pull out the cotter pin holding the drive gear nut and remove the nut.

Push the drive pinion off by tightening the adjusting nut against the thrust bearing spacer.

This will usually be sufficient to remove the drive pinion; however, should it stick, a few sharp blows with a lead hammer, or block of wood against the threaded end of the propeller shaft will loosen the gear so it can be removed.

The bearings and spacing washers can then be taken off the shaft.

Removing Pinion Shaft Thrust Bearing

Remove the thrust bearing lock screw. (See Fig. 81.)

Unscrew the thrust bearing lock nut.

Assembling Propeller Shaft in Housing

In reassembling the propeller shaft assembly, the above operations are reversed. Be absolutely sure to set the various parts up tight. Also, do not forget to install the spacing washer key.

Lock the pinion shaft adjusting nut lock screw with a wire.

Replace and draw tight the thrust bearing adjusting cage lock bolt.

Disassembling Rear Axle Model "G"

Removing Propeller Shaft Assembly

Remove the axle from under the car.

Remove the five propeller shaft housing bolts, clamping the propeller housing to the rear axle housing and lift off. (Fig. 84).

Remove the propeller shaft adjusting lock.

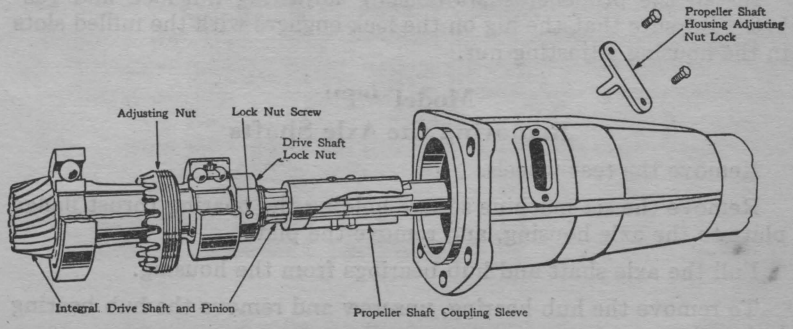


Fig. 83—Removing Propeller Shaft, Model G

With a spanner wrench or screw driver back the drive shaft housing nut out of the threaded inside surfaces of the housing by turning it from the left to the right.

Then with the assembly in a vertical position, with the spline end of the propeller shaft down, drop on a wooden block or wooden floor.

Replacing Drive Pinion Gear and Shaft

The pinion gear on this model is integral with the pinion shaft and is connected to the propeller shaft by a propeller shaft coupling.

To replace the pinion, and shaft remove the propeller shaft from the housing. (Fig. 83.)

Remove the cotter pin from the propeller shaft coupling and pinion shaft.

Remove the pinion shaft from the coupling.

Remove the pinion shaft nut lock and unscrew the pinion shaft lock nut.

Press the bearings and bearing spacer off the pinion shaft.

Adjusting Thrust Bearings

After the thrust bearing has been replaced, draw the lock nut (Fig. 83) up snug against the bearing and tighten the pinion shaft nut lock screw.

Assembling Propeller Shaft in the Housing

In reassembling the propeller shaft assembly the above operations are reversed. Be sure to set the various parts up tight.

Stand the propeller shaft assembly in a vertical position, gear down, and slide the housing over the shaft.

At the upper end of the housing is located a bushing through which the shaft must pass.

Install the propeller shaft housing adjusting nut lock and gasket. Be sure that the lug on the lock engages with the milled slots in the housing adjusting nut.

Model "T"

Removing the Axle Shafts

Remove the rear wheels.

Remove the six machine screws holding the bearing thrust flange plate to the axle housing, and remove the plate.

Pull the axle shaft and hub bearings from the housing.

To remove the hub bearing, unscrew and remove the hub bearing lock nuts.

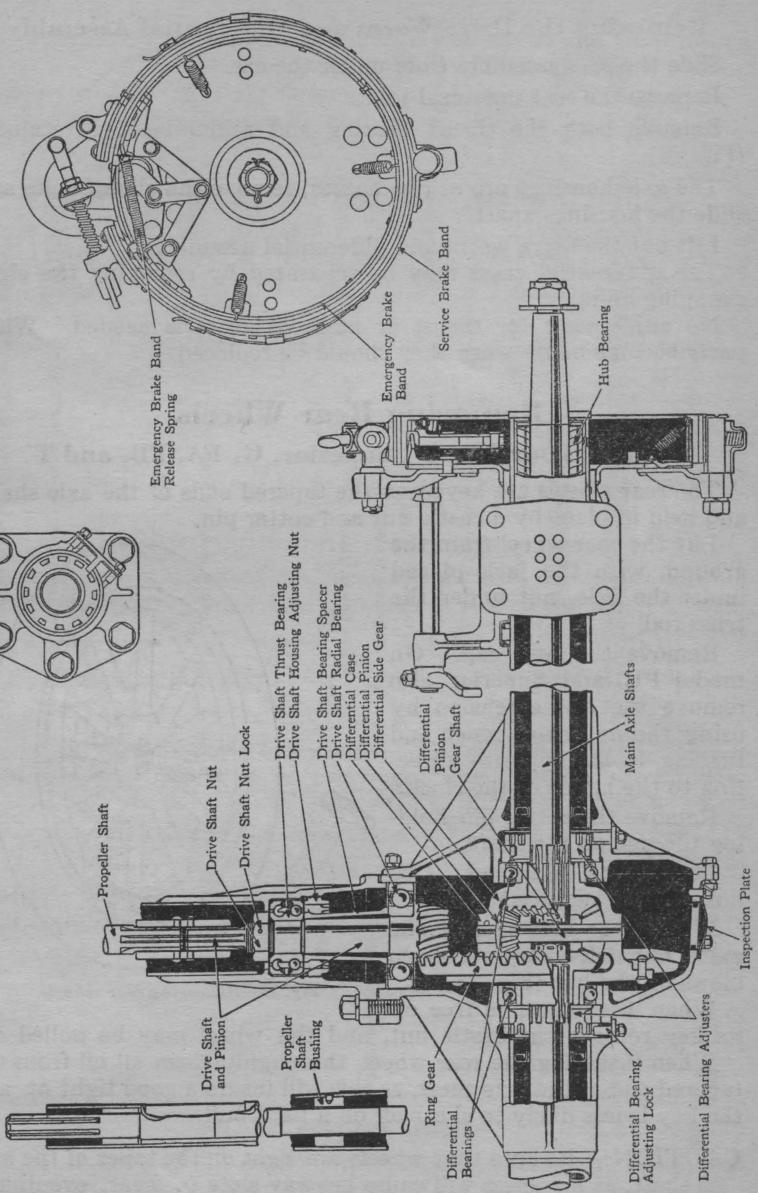


Fig. 84—Rear Axle, Model G

Removing the Drive Worm and Differential Assembly

Slide the axle assembly from under the car.

Remove the rear universal joint.

Remove both the thrust bearing and radial bearing retainers (Fig. 86).

The axle housings are in two halves; remove the clamp bolts and slide the housings apart.

Lift out the drive worm and differential assembly.

The differential cases may be separated by removing the eight clamping bolts.

No adjustment for thrust or mesh of gears is needed. When parts become badly worn they should be replaced.

Removing Rear Wheels

Models Four-Ninety, Superior, G, FA, FB, and T

The rear wheels are keyed on the tapered ends of the axle shafts and held in place by a castle nut and cotter pin.

Lift the rear wheel from the ground, with the jack placed under the axle, not under the truss rod.

Remove the hub cap. On model FB and Superior also remove the hub extension by using the hub cap wrench and turning in the opposite direction to the hands of the clock.

Remove the cotter pin holding the nut on the shaft.

Loosen the castle nut. (Do not entirely remove.)

With a bar held against the castle nut, deliver several sharp blows on the bar (Fig. 85).

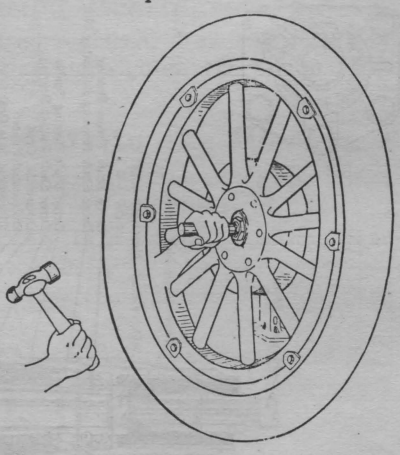


Fig. 85—Removing rear wheels

When the wheel is free on its key remove the castle nut, and the wheel may be pulled off.

When installing the rear wheel, thoroughly clean all oil from the tapered end of the axle shaft, as this will insure a good tight fit, and the key is less likely to shear off on a hard pull.

CAUTION:—Be sure that wheels are tight on the taper of the axle shaft, as looseness will cause keyway slots to wear, eventually necessitating the replacement of the axle shaft or wheel hub, or both.

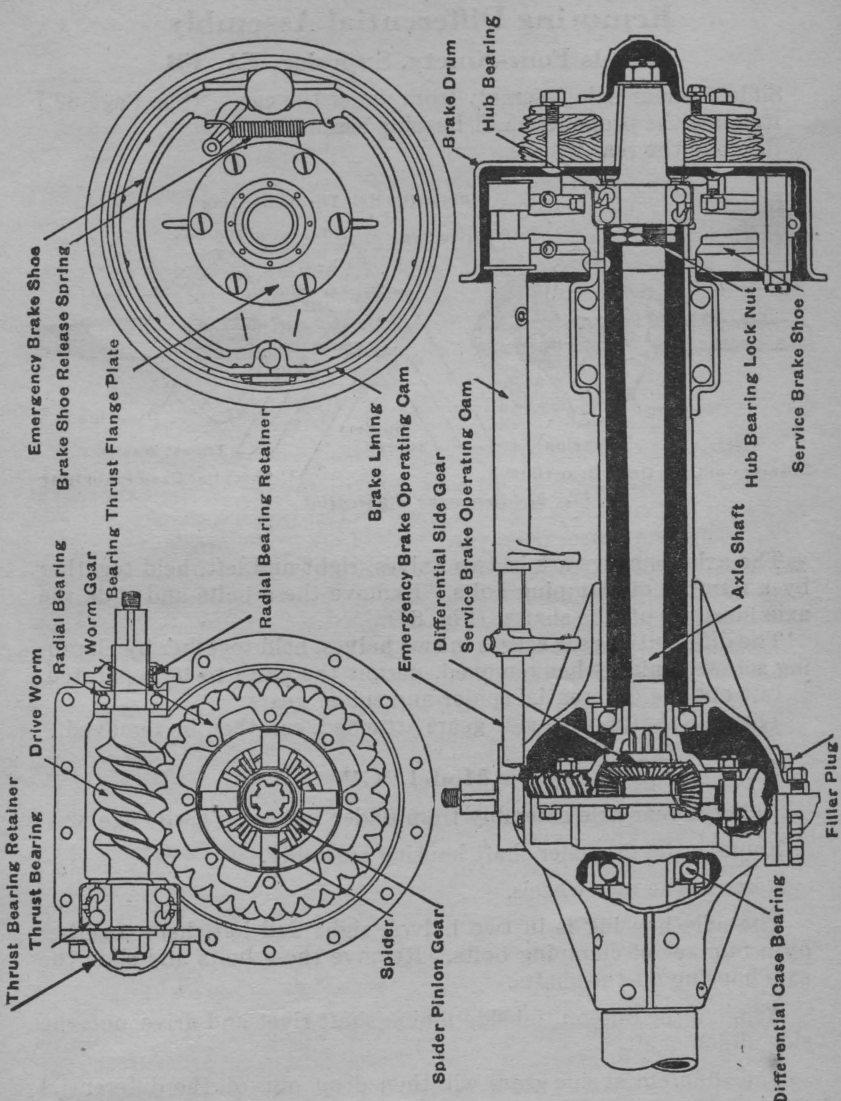


Fig. 86—Rear Axle, Model T

Removing Differential Assembly

Models Four-Ninety, Superior, FA, FB

Slide the rear axle assembly from under the car. (See Page 82.)
Remove the propeller shaft housing assembly.
Remove the rear wheels.

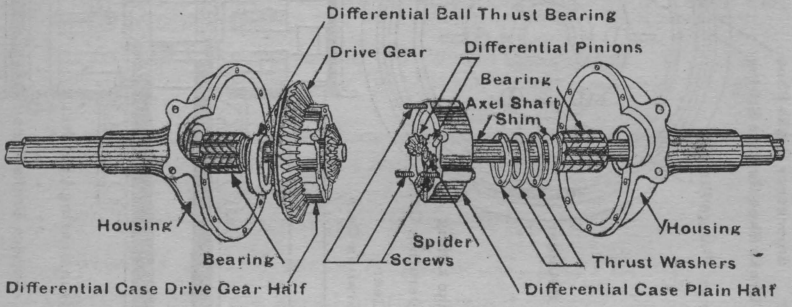


Fig. 87—Removing differential

The axle housings are in two halves, right and left, held together by a number of clamping bolts. Remove these bolts and slide the axle housings off the shafts. (Fig. 87).

The differential gear case is in two halves, held together by clamping screws, which, when removed, permit the cases to be separated.

Lift out the differential spider and spider gears.

The axle shafts, with side gears attached, can then be removed.

Model "G"

Slide the rear axle assembly from under the car. (See Page 82.)

Remove the propeller shaft housing assembly.

Remove the rear wheels.

The axle housing is in two halves, right and left, held together by a number of clamping bolts. Remove these bolts and slide the axle housing off the shafts.

Remove the differential side pinion shaft rivet and drive out the side pinion shaft.

The differential side gears will then drop out of the differential case.

Remove main axle shaft differential end nuts.

Remove the axle shafts.

To assemble the differential, the operations are reversed.

Removing Differential Side Gear

Models Four-Ninety, Superior, FA, FB

Press the gear on the shaft, toward the tapered end. (Fig. 88). This will release the two split lock rings.

Press the gear off the shaft.

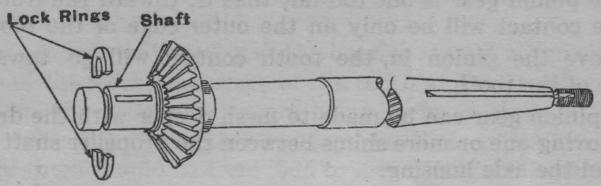


Fig. 88—Removing differential side gear.

Adjusting Rear Axle Gears

Models "Four-Ninety" (Straight Tooth Gear) "FA"

Assemble the differential and axle shafts.

Smear the face of the teeth on the pinion gear with Prussian Blue, lamp black, or some other suitable coloring matter.

Slide the axle housings in place and bolt together.

At this point there should be no side play to the differential and it should turn freely.

Install the propeller shaft housing assembly. Place one light and one heavy metal shim, also a paper gasket, between the propeller shaft and axle housings.

Grip the splined end of the propeller shaft with a wrench, and turn at least twenty revolutions.

Remove the filler plug on the axle housing, and, by projecting a light into the gear case, note the marks made by the pinion on the drive gear teeth.

For a properly adjusted gear the bearing should cover about one-third of the working face of the tooth at the "toe" end. This is without the differential gears being under a strain. With the axle in operation the teeth will bear over their entire working face.

Between the differential thrust bearing and the differential case you will observe several thin metal washers or shims.

To move the drive gear to the right, take out one shim from the right side and install it on the left.

To move the drive gear to the left, reverse these operations.

If you have a heel contact on the bearing surface of the teeth instead of on the toe, it indicates too much back lash and the drive gear should be moved toward the pinion.

A gear properly adjusted should have approximately .005 to .008 of an inch back lash.

If the pinion gear is out too far, that is, toward the front of the car, the contact will be only on the outer edge of the tooth. As you move the pinion in, the tooth contact will go towards the bottom of the tooth.

The pinion gear can be made to mesh deeper with the drive gear by removing one or more shims between the propeller shaft housing base and the axle housing.

To move the pinion outward, add one or more shims.

After making the adjustment that seems necessary, assemble the axle housings and bolt together.

When installing the propeller shaft housing assembly. Do not forget to replace the shims and gasket between the propeller shaft and axle housings.

If the tooth bearing is still improper, try again.

After securing the proper tooth bearing, test for "back lash."

Holding the drive gear with a screw driver passing through the filler plug hole, turn the propeller shaft and note the movement obtained. This represents the amount of play between the gear teeth.

If there is too much "lash," remove the light shim from between the propeller shaft and axle housings. It may be necessary to remove the heavy shim to get proper mesh.

If the gears mesh too deeply, causing the gears to bind, install additional shims between the propeller shaft and axle housings.

After having secured a proper fit do not forget to lubricate the differential as instructed.

Models Four-Ninety, (Spiral Tooth Gear) Superior

Follow the same procedure as when adjusting straight tooth gears—except that for a properly adjusted gear the back lash should be very slight—just enough to permit the gears to revolve without binding.

Model "FB"

Assemble the differential and axle shafts.

Smear the face of the teeth on the pinion gear with Prussian blue, lamp black or some other suitable coloring matter.

Slide the axle housings in place and bolt together.

At this point there should be no side play to the differential, and it should turn freely.

Install the propeller shaft housing assembly.

Grip the splined end of the propeller shaft with a wrench, and turn at least twenty revolutions.

Remove the filler plug on the axle housing, and by projecting a light into the gear case note the marks made by the pinion on the drive gear teeth.

For a properly adjusted gear the bearing should cover about five-eighths of the working surface of the tooth at the "toe" end. This is without the differential gears being under a strain. With the axle in operation the teeth will bear over their entire working surface and there should be from .005 to .008 of an inch back lash.

If there is too much lash, remove the hand hole plate (Fig. 81) and loosen the thrust bearing adjusting cage bolt.

By inserting a punch or a round rod into the slots on the end of thrust bearing adjusting cage, it can be turned to the right, thus moving the drive pinion into closer mesh.

After securing the proper tooth bearing, test for back lash.

When the desired mesh is obtained, replace the hand hole plate. Be sure that the lug on the bottom of the plate engages one of the milled slots on the end of the thrust bearing adjusting cage.

Tighten the thrust bearing adjusting cage bolt so that the adjusting cage will remain in position.

It is not always possible to adjust gears in the shop to a perfect tooth bearing and have them quiet; so that the best method is to set the adjustment having about the proper bearing and back lash, then take the car out on the road.

It may be necessary to move the pinion gear slightly one way or the other in order to get the most quiet running adjustment.

Model "G"

Assemble the differential and axle shafts.

Smear the teeth of the pinion gear with Prussan blue or lamp black or some other suitable coloring matter.

Slide the axle housing in place and bolt together.

Attach the propeller shaft housing assembly. Be sure the propeller shaft housing steel shim is in place.

The differential can be moved to the right or left to secure a proper mesh of the differential gears by removing the differential bearing adjuster locks (Fig. 84) and turning the differential bearing adjusters located on either side of the differential, with a punch or screwdriver.

By turning both bearing adjusters to the right the bevel ring gear is brought in closer mesh with the pinion gear. By turning them to the left, the clearance between the teeth of the gears is increased.

For a properly adjusted gear the bearing should be along the entire face of the tooth and there should be just enough lash to prevent the gears from binding when revolving. An inspection can be made by removing the inspection plate on the axle housing.

There should be no side play in the differential, yet it should turn freely after the proper mesh has been obtained.

When the desired mesh has been obtained replace the bearing adjuster locks.

Be sure that the lug on the locks engages with the milled slots in the bearing adjuster.

Replace the inspection plate

Adjusting Brakes

Models Four-Ninety (Equipped with Hand Brake Lever) and Superior

When the brake pedal is pressed downward as far as it will go without stopping the forward movement of the car, shorten the rod between the pedal and the brake shaft on the propeller shaft housing by turning the turnbuckle E (Fig. 89) to the right. When the hand brake lever is pulled back as far as it will go without stopping the forward movement of the car, shorten the rod between the hand lever and the brake shaft on the propeller shaft housing by the turn-

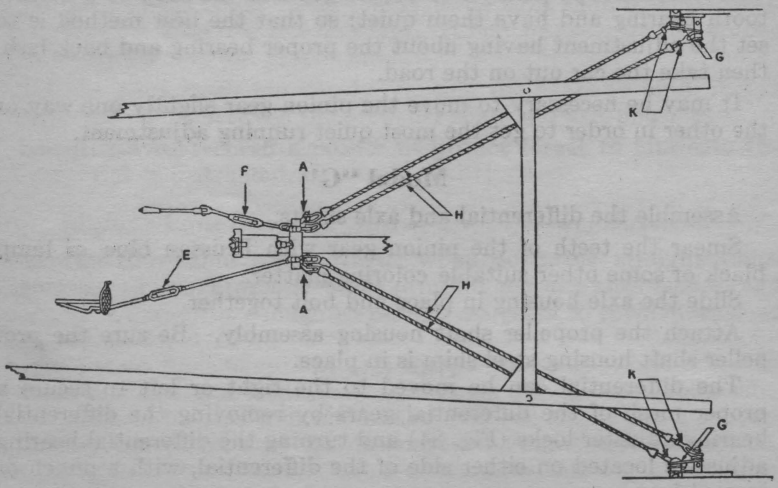


Fig. 89—Brake adjustment, Model Four-Ninety (with hand brake) Superior.

ing of the turnbuckle F (Fig 89) to the right. When these adjustments are being made, a jack should be placed under the rear axle and the rear wheels raised from the ground so that they can be turned from time to time to see that the brakes are not dragging.

After making this adjustment note the position of levers "A," (Fig. 89) (with the brakes released) which are attached to the brake shaft on the propeller shaft housing. To give proper pull on the brake cables these levers should point downward and about one inch to the rear of a vertical position.

If these levers stand in a vertical or forward from vertical position with the brakes released, unscrew the turnbuckle E or F and remove the yoke pins G from the brake pin levers and shorten the brake cables H by turning the yoke nuts K to the right until the levers A assume their proper position.

Caution—Be sure to turn each of the yoke ends an equal number of turns otherwise one brake will take hold before the other.

The turnbuckle E or F can then be adjusted so as to bring the cables H tight.

Should one brake "grab," that is, take hold too quickly, remove the yoke pin G on that brake and lengthen the cable H by unscrewing slightly the yoke nut K.

After considerable use, the brake bands will become worn to such an extent that it will be necessary to replace them. When the service brake operating lever or the emergency brake operating lever (Fig. 89) stands in a vertical or forward of vertical position with the brake applied, it indicates that the brake linings have become worn to the point where they should be replaced.

Brakes

Adjustment of Brakes—Model Four-Ninety (Not Equipped with Hand Brake Lever)

As the brakes are used, the brake linings become worn.

When either pedal is pressed as far down as it will go without stopping the forward movement of the car, shorten the rods between that pedal and the brake shaft on the propeller shaft, by turning the turnbuckle E or F. to the right. (Fig. 91).

After making this adjustment note the position of levers A (with the brakes released) attached to the brake shaft on the propeller shaft housing. To give proper pull, these levers should point downward and about one inch to the rear of a vertical position.

If these levers stand in a vertical or forward from vertical position, unscrew the turnbuckles E or F.

Remove the yoke pins G from the brake bands, and shorten

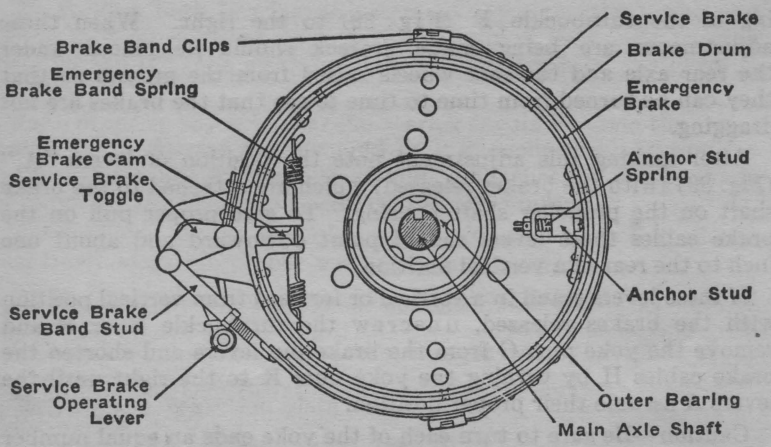


Fig. 90—Brake bands, Model Four-Ninety and Superior.

the brake cables H by screwing in on the yoke ends K until the levers A assume their proper position.

Caution.—Be sure to turn each one of the yoke ends an equal number of turns, otherwise one brake will take hold before the other.

The turnbuckles E or F can then be adjusted so as to bring the cables H tight.

Should one brake "grab," that is, take hold too quickly, remove the yoke pin G on that brake and lengthen the cable H by unscrewing slightly the yoke end K.

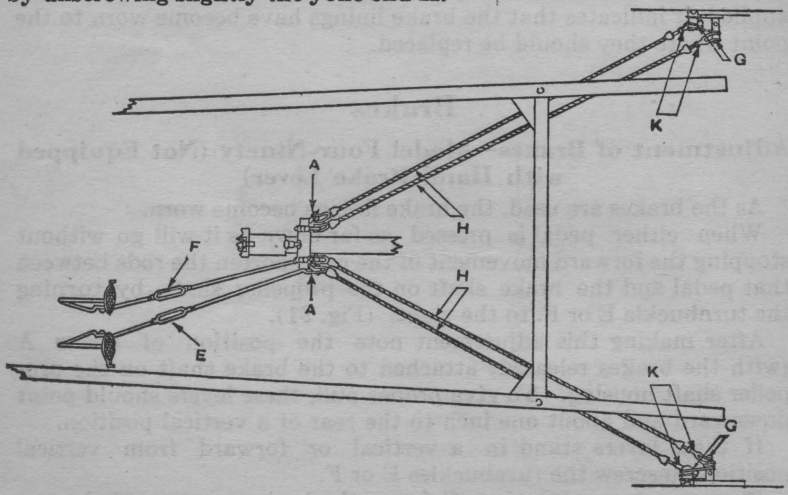


Fig. 91—Brake adjustment, Model Four-Ninety (without handbrake.)

Whenever the service brake operating lever, (Fig. 91), or the emergency brake operating lever, stand in a vertical or forward position with the brakes applied it indicates that the brake linings have become worn to the point where they should be replaced.

Additional use may be obtained on the service brake lining by removing the yoke pin, holding the service brake band stud, Fig. 90) and screwing down on the stud.

Adjustment of Brake Bands—Model "FA"

To secure proper braking action the brake bands must be adjusted so that when applied they grip the brake drums evenly and at all points.

Should the service brake band bear on the drum at the bottom and not at the top screw upward on the toggle link adjusting nuts (Fig. 92), until the upper half grips the drum properly.

Should the service brake band touch the drum at the top and not at the bottom, screw upward on the adjusting thumb nut (Fig. 92) until the lower half grips the drum properly.

The object is to obtain an adjustment so there is the same amount of clearance between the entire bearing surface of the brake and the outside surface of the brake drum. Then when the brakes are applied they will grip the entire circumference of both the brake drums at the same time.

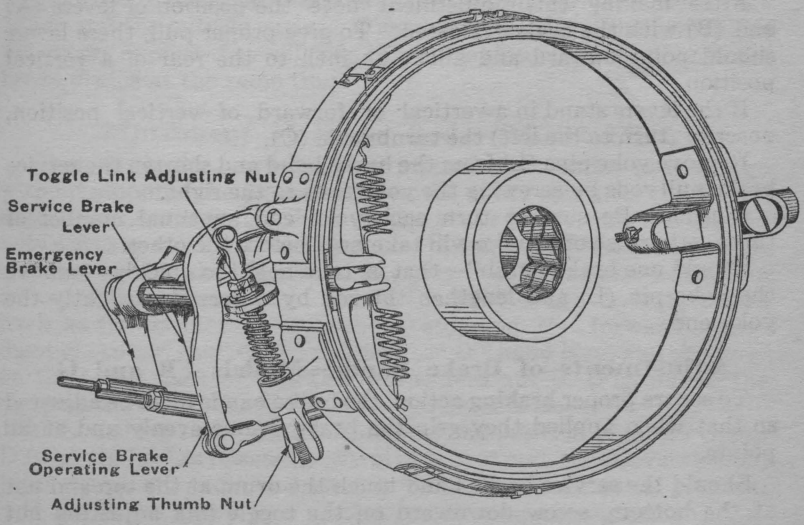


Fig. 92—Brake bands, Model FA.

Adjustment of Brake Rods—Model FA

When either the brake pedal is pressed down, or the hand lever pulled back as far as it will go without stopping the forward movement of the car, after the proper adjustment has been obtained

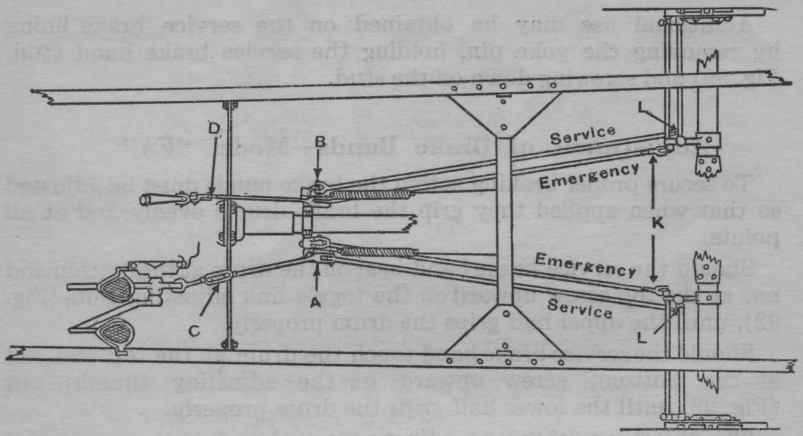


Fig. 93—Brake adjustment, Model FA

on the brake bands, shorten the rods between the pedal or lever and the brake shaft on the propeller shaft housing by screwing the turnbuckle (C), or adjusting yoke end (D) (Fig. 93) to the right.

After making this adjustment note the position of levers (A) and (B) with the brakes released. To give proper pull, these levers should point upward and about an inch to the rear of a vertical position.

If the levers stand in a vertical or forward of vertical position, unscrew (turn to the left) the turnbuckle (C).

Remove yoke pins (L) from the brake band and shorten the service brake pull rods by screwing the yoke ends to the right.

Caution—Be sure to turn each yoke end an equal number of turns, otherwise one brake will take hold before the other.

Should one brake "grab"—that is, take hold too quickly—remove the yoke pin (L) and lengthen the rod by unscrewing slightly the yoke end.

Adjustments of Brake Bands—Models FB and G

To secure proper braking action, the brake bands must be adjusted so that when applied they grip the brake drums evenly and at all points.

Should the service brake band touch the drum at the top and not at the bottom, screw downward on the toggle link adjusting nut (Fig. 94), until the lower half grips the drum properly.

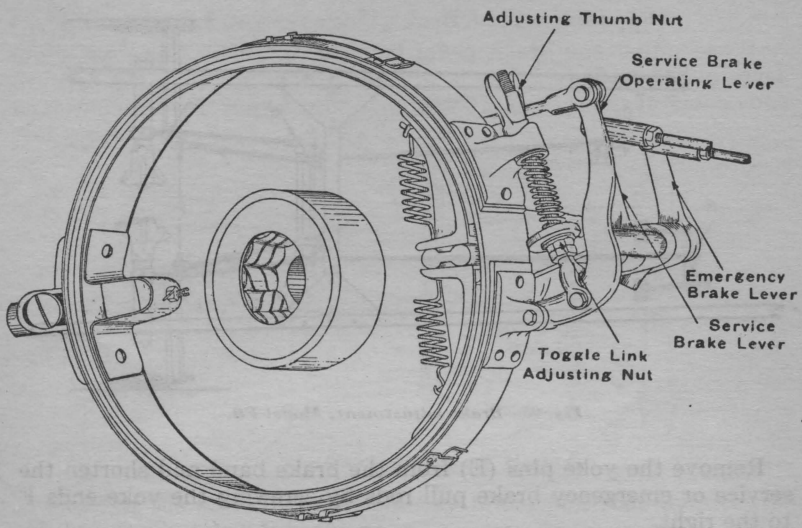


Fig. 94—Brake bands, Model FB.

Should the service brake band touch the drum at the bottom and not at the top screw down on the adjusting thumb nut (Fig. 94), until the upper half grips the drum properly.

The object is to obtain an adjustment so that there is the same amount of clearance between the entire bearing surface of the brake bands and the outside surface of the brake drum. Then when the brakes are applied they will grip the entire circumference of both the brake drums at the same time.

Adjustment of Brake Rods—(Model FB)

When the brake pedal has been pressed down as far as it will go without stopping the forward movement of the car, after the proper adjustment has been obtained on the brake bands, shorten the rod between the pedal and brake shaft (D) by raising the hood on the left side and turning the thumb nut (A) (Fig. 95), in the same direction as the hands of a clock. When the hand brake lever is pulled back as far as it will go without stopping the forward movement of the car, shorten the rod between the hand lever and the lever on the brake shaft by screwing the thumb nut B, (Fig. 95) to the right or the same direction as the hands of a clock.

After making these adjustments note the position of levers C and D (with the brakes released). To give proper pull, these levers should point downward and about an inch to the rear of a vertical position.

If the levers stand in a vertical or forward of vertical position, unscrew the thumb nuts (A) and (B).

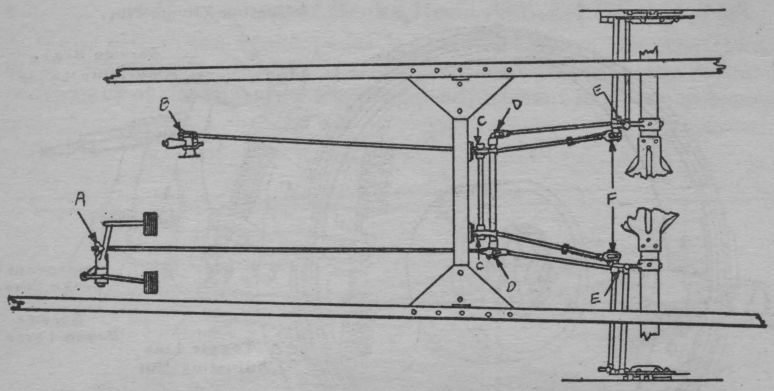


Fig. 95—Brake adjustment, Model FB.

Remove the yoke pins (E) from the brake band and shorten the service or emergency brake pull rods by screwing the yoke ends F to the right.

Caution.—Be sure to turn each yoke end an equal number of turns, otherwise one brake will take hold before the other.

Should one brake "grab"—that is, take hold too quickly—remove the yoke pin E and lengthen the rod by unscrewing slightly the yoke end F.

Whenever the service or emergency brake operating levers (Fig. 95) stand in a vertical or forward of vertical position (with the brakes applied) it indicates that the brake linings have become worn, to the point where they should be replaced.

Additional use may be obtained on the service brake by screwing the adjusting thumb nut (Fig. 94) to the right.

Adjustment of Brake Rods Model G

When the brake pedal is pressed downward or the hand brake lever is pulled backward as far as it will go without stopping the forward movement of the car, after the proper adjustment has been obtained on the brake bands, shorten the rods between the pedal or lever and the brake rocker shaft, on the frame cross member, by screwing the turnbuckles (D and C), (Fig. 96) to the right or the same direction as the hands of a clock.

After making this adjustment note the position of the levers on rocker shafts with the brakes released. To give the proper pull these levers should point downward and about an inch to the rear of a vertical position.

If these levers stand in a vertical, or forward of vertical position, unscrew the turnbuckles D and C.

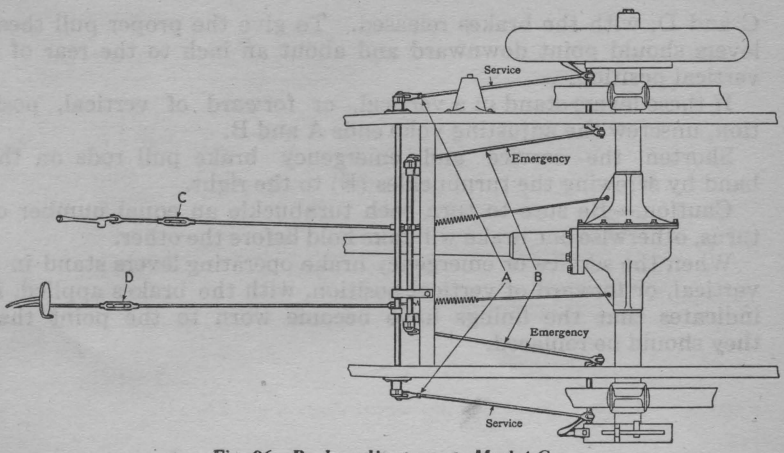


Fig. 96—Brake adjustment, Model G

Shorten the service and emergency brake pull rods by screwing the yoke ends A and B to the right.

Caution—Be sure to turn each yoke and an equal number of turns, otherwise one brake will take hold before the other.

When the service or emergency brake operating levers stand in a vertical, or forward vertical position, with the brakes applied, it indicates that the linings have become worn to the point that they should be replaced.

Adjustment of Brakes—Model T

When either the brake pedal is pressed down or the hand brake lever is pulled back as far as it will go without stopping the forward movement of the car, shorten the rods between the pedal and lever to the brake rocker shaft, on the frame cross member, by screwing the adjusting yoke ends (A and B), (Fig. 97), to the right.

After making this adjustment note the position of the levers

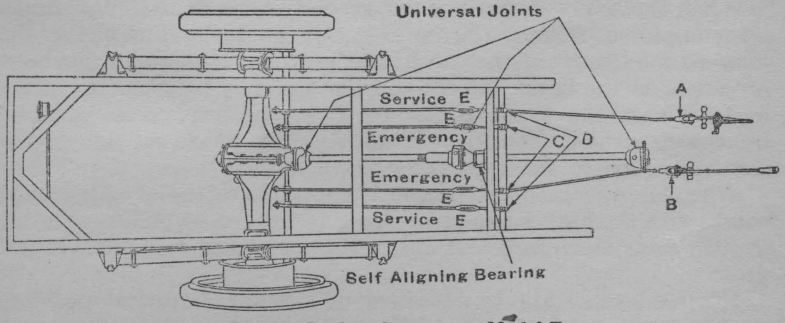


Fig. 97—Brake adjustment, Model T

C and D, with the brakes released. To give the proper pull these levers should point downward and about an inch to the rear of a vertical position.

If these levers stand in a vertical, or forward of vertical, position, unscrew the adjusting yoke ends A and B.

Shorten the service and emergency brake pull rods on the band by screwing the turnbuckles (E) to the right.

Caution.—Be sure to turn each turnbuckle an equal number of turns, otherwise one brake will take hold before the other.

When the service or emergency brake operating levers stand in a vertical, or forward of vertical position, with the brakes applied, it indicates that the linings have become worn to the point that they should be replaced.

Chapter III

◆

Adjustment and Care of Bodies

Instructions for Attaching Strips at Lower End of Glass Channel in Sedan Doors to Prevent Breakage of Glass

Remove the upholstering from the door and lower the glass unit about two-thirds of the way down, so that it will act as a guide when attaching the wood strips to each side of the felt channel. These strips should be ½" x ½" and long enough to extend from the window ledge to the lower end of the channel in which the door glass runs.

The strip on the side of the glass next to the upholstering should be attached first in order to insure perfect alignment. The glass can then be raised and the strip on the opposite side of the felt channel attached. It is very essential that this channel be absolutely straight in order to prevent the glass from binding at any point and the glass should slide freely in the channel.

If the lifting arm, which is attached to the lower end of the glass, does not operate freely in all positions, an adjustment should be made at the bracket, which is attached to the frame of the door, as the holes in the bracket are slotted so its position can be changed. The arm should never be bent as this will give it a tendency to bind. A portion of the lining board should be cut away as indicated in the sketch so that the regulator will not rub against it and bind. The tension of the regulator spring can be increased or decreased by hooking it in the different holes in the regulator arm. Before replacing the upholstering a small amount of cup grease should be distributed in the steel channel at the lower end of the glass in which the lifter arm roller travels.

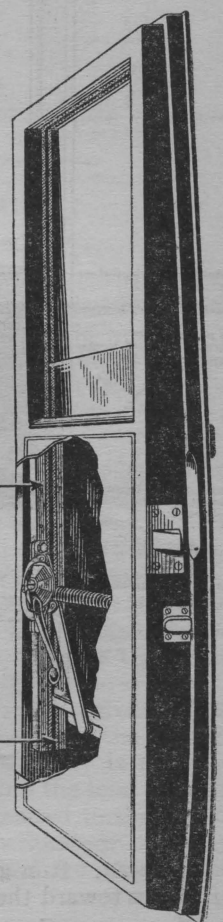


Fig. 98—End view of Sedan Door

To Remove Glass Without Disturbing Upholstery

FIRST: Run glass down to bottom of door.
SECOND: Remove trim sticks.
THIRD: Unfasten felt runway channel.

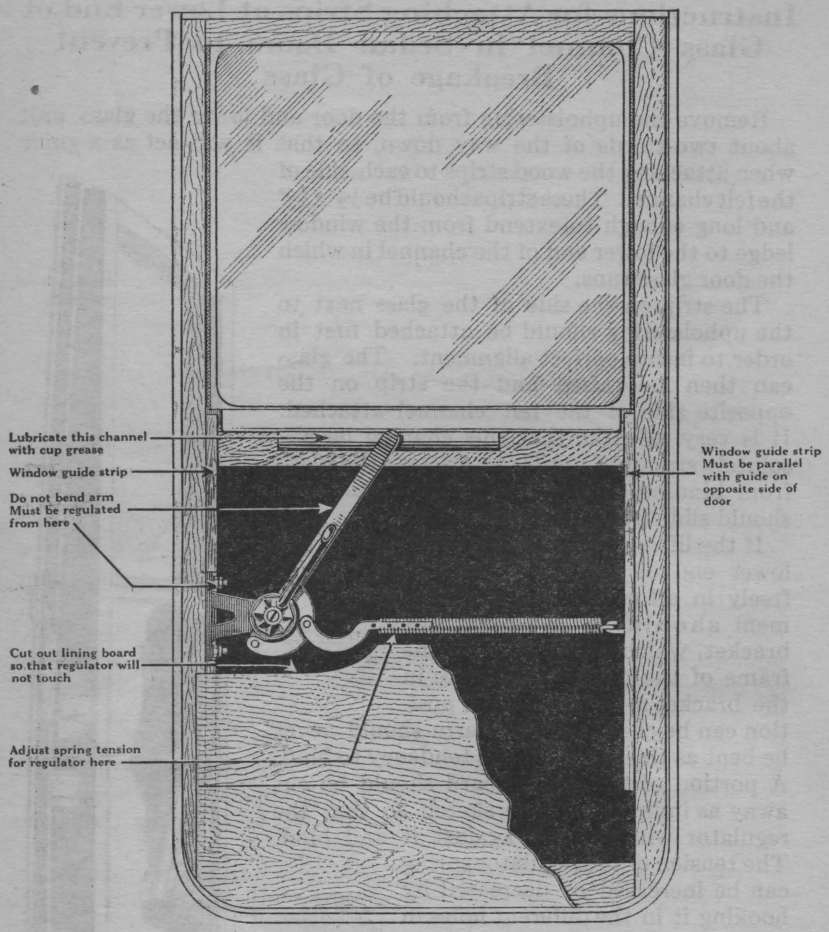
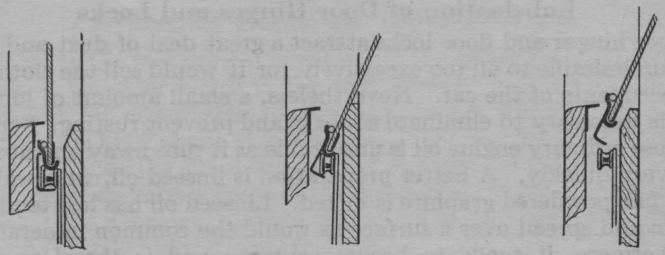


Fig. 99—Side view of Sedan Door

FOURTH: Run glass up to within an inch or two of top and tip glass toward the inside of the door as shown in Fig.100, Sketch B.

REPLACING GLASS: Be sure to engage arm roller in glass channel as shown in Fig. 100, Sketch A.



Sketch A
Normal position of glass in place

Sketch B
Proper position for removing glass

Sketch C
Indicating roller disengaged from glass channel

Fig. 100—Removing Glass without disturbing upholstery

General Body Adjustments

Body Bolts Tight

The sill, or frame work of an automobile body is necessarily made of wood. In order to secure it rigidly to the frame a number of bolts are required, but, on account of these bolts being set in wood there is a tendency to loosen after the first few hundred miles of service. Body bolts should be checked every month for the first few months. After that time, if there is no continual tendency to loosen up, they will remain tight indefinitely.

Perhaps one of the most frequent complaints on a modern automobile is about the squeaks and rattles which seem to emanate from the body. Few owners appreciate that these are aggravated by neglecting to see that the body bolts are always tight. It is impossible to eliminate a squeak for any time if there is any looseness or working of the sill upon the frame. Therefore, before any attempts are made to eliminate squeaks and rattles, the body bolts must be checked up to make sure that they are drawn down as tightly as possible.

If the body is allowed to remain loose on the frame, a great deal of objectionable noise will result. In addition to the noise, the damage done to the frame work of the body will be serious. It must be clearly understood therefore, that the ridigity and the long life of a body depends entirely upon its being securely bolted to the frame. As soon as it is allowed to remain loose, it is weakened. Squeaks and rattles can not be successfully eliminated, and the joints in the metal panels will sooner or later open up.

Door Bumpers

The bumpers on the doors require renewal in proportion to the amount of usage they receive. New door bumpers are on hand at all of our branches so that they may be replaced whenever necessary. Neglect to replace door bumpers results in worn hinges and locks.

Lubrication of Door Hinges and Locks

Door hinges and door locks attract a great deal of dust and dirt. It is undesirable to oil too excessively for it would soil the clothes of the occupants of the car. Nevertheless, a small amount of lubrication is necessary to eliminate squeaks and prevent rusting. For this purpose ordinary engine oil is unsuitable as it runs away and absorbs dirt very quickly. A better preparation is linseed oil, with which a little fine powdered graphite is mixed. Linseed oil has less tendency to run and spread over a surface as would the common mineral oils. Furthermore, it tends to become gummy and is therefore more effectual in retaining the graphite at the required spot for a greater period of time.

Adjusting Doors on the Model Four-Ninety and FA

Spaced at intervals between the sill, or frame of the body, and the steel frame of the car, are shims or spacers made from heavy pieces of fabric or belting material in order to take care of slight irregularities in the sill of the body and to provide an even bearing surface. Upon the thickness and spacing of these shims depends the satisfactory operation of the doors of the car.

If, after considerable use, the rear doors of the car are inclined to come open without the door lock being turned, it is an indication that there is too much space between the door and the upright on the body at the point where the door lock and catch is attached.

By loosening the rear body bolts and elevating the rear of the body by placing a piece of heavy fabric or wood a few inches in length, between the frame of the car and the body sill, the gap between the door and the upright on the body will be decreased. The thickness of the shim will depend entirely upon the amount of excess clearance there is for the door.

It is a good plan to remove the body bolts entirely, drill a hole in the shim so that the bolt, when replaced, will go through the shim and hold it in the proper position. Be sure that the body bolts are drawn down tight.

If the front doors will not stay fastened, loosen the front body bolts which are immediately beneath the front toe board cleats, and proceed in the same manner as outlined above.

If the front and rear doors are inclined to bind at the door locks, remove the shims at the front and rear of the body, as the case may be, or replace with thinner shims until the proper operating clearance is obtained. If there are no shims at either point and the body sill is resting against the frame of the car, loosen the body bolts immediately below the doors and with a wedge or a tapered bar placed between the sill of the body and the frame of the car, elevate the sill and insert a shim of sufficient thickness to give the proper clearance of the doors.

Adjusting Doors on the Model FB

Located in the tool compartment under the driver's seat, also at an opening in the floor board in the rear tonneau just in front of the heel board on either side of the car, is an adjusting screw with a square head about 1" in diameter. These screws go through a casting bolted to the sill of the car and rest against the frame of the car. Upon these screws depends the position of the sill of the body in order that the doors will operate properly, the body sill being held to the frame by bolts in the usual manner.

If the front doors have an excess amount of clearance at the door locks so that the vibration of the car, when operated over rough roads, will tend to open them, back the screw out a short distance until the proper adjustment is obtained. If the doors are too tight, run the screw down a little deeper. This will increase the distance between the upright door frames on the body.

Proceed with the adjustment of the rear doors in the same manner.

Chapter IV

Carburetion and Electrical System

for Economical Transportation

Carburetor

We do not recommend that the novice attempt adjustments on the carburetor. The carburetor has been carefully tested and properly adjusted with the motor at the factory, and no further

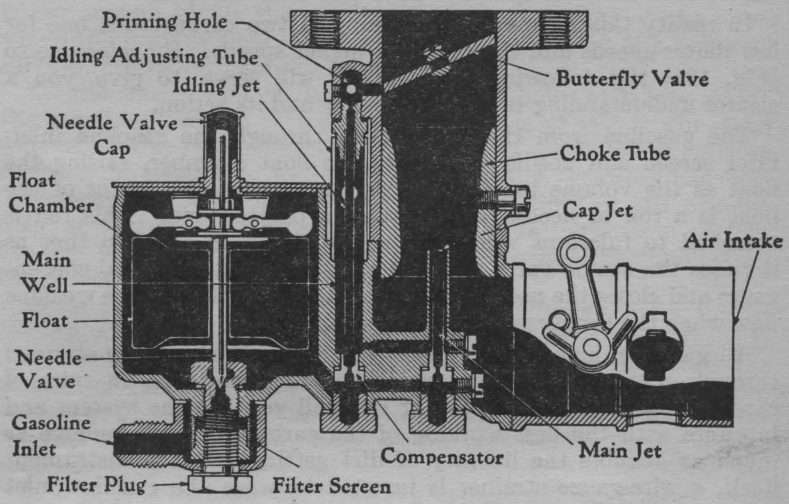


Fig. 101—Carburetor (Zenith)

adjustment should be necessary. Too often the carburetor is adjusted or tampered with when in reality something else is causing the motor to run unevenly.

Dirt may be causing the motor to miss fire and to "pop" or "sputter," and in this event, remove the filter plug (Fig. 101), which allows the gasoline inlet connection to slide off the boss on the end of the carburetor. Surrounding this boss is the filter screen or strainer. Remove and cleanse thoroughly. Care must be exercised in replacing the screen, as trouble will result if the screen is damaged in any way.

On each suction stroke of the piston a partial vacuum is created which causes a fine spray of gasoline to flow from the carburetor jets. This spray is picked up by the air, which is also drawn through the fixed air intake (Fig. 101), and as it passes through the choke or "venturi" a rotative action is produced (by the special shape of the choke) which breaks up the fine particles of gasoline, and, thoroughly mixing with the air, passes into the cylinder through the intake pipe in the form of a carbureted gas.

Carbureting Principle.

The proper carbureted mixture is composed of fifteen parts of air to one part of gasoline vapor, but since in the ordinary carburetor the flow of gasoline from the jets increases under suction faster than the flow of air, it is necessary to provide a means of regulating the flow for all motor speeds so as to maintain this ratio.

In reality this means the combining of two carburetors, one for low motor speeds and the other for higher speeds. By reference to (Fig. 101) the following explanation will serve to give you a clearer understanding of the carburetor and its action.

The gasoline from the tank passes through the gasoline inlet, filter screen and needle valve into the float chamber, raising the float as the volume increases. Passing through the center of the float is a rod or needle valve having a pointed end. This rod is attached to fulcrums which are actuated by the float so that as it raises the needle valve moves downward and the conical end engages and closes the needle-valve seat, thus shutting off the gasoline flow when the proper volume has been obtained.

All gasoline, before being placed in the tank, should be strained through chamois to remove water and dirt; however, in spite of care a certain amount of dirt or lint will get into the system and interfere with the best working of the carburetor. To remove as much as possible the liability of dirt getting into the instrument itself, a wire-gauze strainer is inserted between the gasoline inlet pipe and the float chamber.

The principle around which the carburetor is built is known as the compound nozzle—one on which the suction created by the motor acts directly on a column of gasoline passing from the float chamber through the passage and into the main jet — the other on which the suction acts on a measured quantity of gasoline passing through the compensator into the open or main well, thence through the passage into the cap jet.

Boiled down, it simply means that at low engine speeds the spray passing from the cap jet is stronger than that from the main jet, but as the motor gains speed and the suction becomes greater the main jet gains in strength while the cap jet becomes weaker. Both jets are in action at all speeds, the defect of one nozzle, starting poor and growing richer until it is about right at high speed, is compensated by the defect of the other, which also starts too poor and keeps growing poorer. One supplements the other so that at every motor speed there is a constant ratio of air and gasoline to supply efficient combustion.

The speed of the motor is controlled by the opening or closing of a throttle or damper called a butterfly valve, which is placed in the upper part of the carburetor. The more this is closed the greater

becomes the obstacle in the path of the incoming gases, and the less each cylinder will fill with gas on each stroke; therefore, the power impulse will be weaker and the motor speed reduced.

When starting the motor, especially when it is cold, an excess of gasoline is necessary to insure combustion. With the butterfly valve only slightly opened the amount of air drawn into the motor is not enough to lift the gasoline from the jets, but at the point where the priming hole enters the carburetor there is a powerful suction rushing through this narrow space.

In the main well is inserted a secondary well into which the gasoline flows, so that when the motor is at rest it will stand in it as high as it does in the float chamber. The suction at starting empties the secondary well and supplies the necessary gasoline. The secondary well also supplies gasoline through the priming hole at low motor speeds—that is, as long as the suction on the cap jet is not great enough to use up all the gasoline supplied by the compensator.

Air is permitted to enter the main well through holes in the casting, and also finds its way into the secondary well through the regulating screw. This screw increases or decreases the amount of gasoline drawn up according to its position, but has no influence whatever on the carburetor action beyond low motor speeds. Adjusting screw, once set for best results, should not be touched.

It will be seen from the foregoing explanation that, aside from the carburetor casting and the float mechanism, the action of the carburetor depends simply upon the size of the choke or venturi and the different gasoline nozzles. When once adjusted to the motor—and this is carefully done at the factory—these sizes can not change through use; if the holes become clogged with lint or dirt, which may happen, it is a simple matter to take the carburetor apart and clean it. Main and compensator jets can be taken out by removing plugs. By using ordinary care in putting it together again, screwing the jets tight, the adjustment will not have been disturbed.

How to Repair the Carburetor

Disassemble the carburetor completely and examine each part.

Clean all parts thoroughly in gasoline, using a stiff brush to remove caked dirt and oil and blow out the jets to remove chips or dirt which may be clogged within the small drilled passage. Be absolutely sure that the idling jet is neither plugged nor corroded.

Reassemble the carburetor, putting in the correct factory settings and test for float level and leaks. Inspect carefully for defects in fibre washers or leaks due to sand holes in the body casting. Leave carburetor on test rack with fuel turned on for at least fifteen minutes or until the exterior becomes absolutely dry.

If due care is exercised in following out the above instructions, further motor troubles can generally be traced to insufficient fuel feed, faulty ignition or poor compression.

Testing and Setting Fuel Levels

This operation calls for a "level test gauge," consisting of a body, a screw for attaching it to the carburetor, and a glass gauge for observation of the fuel level and should be performed by some one familiar with this kind of work. (See Fig. 102.)

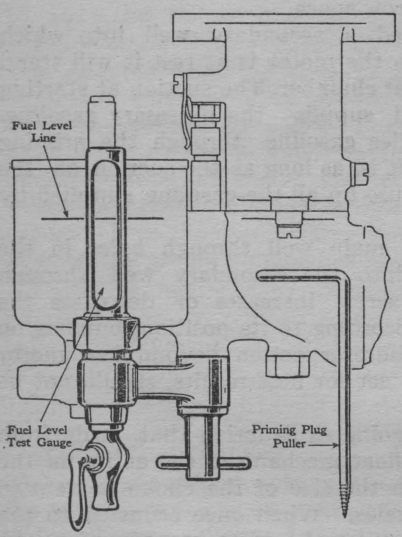


Fig. 102—Level test gauge

The test gauge is attached in place of the lower plug under the compensator jet.

To use the level gauge, attach to carburetor and swing around so the glass gauge is in a position nearly touching the carburetor bowl.

On the side of the bowl a "level line" is scribed to show the exact height to which the gasoline should rise and remain stationary.

A test tank should be used in this operation and one can be made by taking an ordinary half gallon cylinder oil can and solder a fuel line to the bottom. The necessary couplings can be installed on the opposite end of fuel line to attach to the carburetor.

A "shut off" cock should be installed some where in the fuel line, so the gas can be turned "off" and "on" at will.

Place the test tank in a position so the bottom is not less than thirty inches above the carburetor.

When all attachments are made, turn on the gasoline and as it is seen to rise in the gauge glass, note the height in comparison with the "level line."

At least five readings should be made in determining the exact "level."

Needle Valve Adjustment

The only place any adjustment of the level should be attempted is at the needle valve collar, its relative position on the needle valve determining the point of closing of the valve. Remove the float

cover from the carburetor, draw out the wire holding the lever weight axles and remove the needle valve entirely from the cover.

Take a knife, or any sharp instrument, and mark around the needle valve at the lower side of the collar (the side towards the point). This will show the original setting of the collar in case it is found necessary to bring it back to this position.

To lower the level, scratch a mark on the needle valve $\frac{1}{32}$ of an inch above the collar.

Provide a block of hard wood through which a hole slightly larger than the largest diameter of the needle valve has been drilled. Put the needle valve into this, with the point down.

Now, with a flame soften the solder holding the needle valve collar on the valve, first wetting it with soldering acid or paste, and when the valve is free in the collar tap it down to the upper mark, or $\frac{1}{32}$ of an inch. Allow it to cool, thus again setting the solder, and replace in the float cover. This will lower the level.

If further lowering is found necessary repeat the above, but never go further than $\frac{1}{32}$ of an inch at a time.

Next, replace the cover on the carburetor, press the needle valve down tight against its seat with the finger and make a line around it at the upper edge of the boss on the cover that takes the thread of the dust cap. Remove the cover from the carburetor and with the fingers bring the mark on the valve back to the above position and see what position the lever weights are set. If they are not horizontal it means that you have gone too far, that the travel of the valve will be insufficient, and that the float mechanism will not function properly. This travel should not be less than $\frac{5}{64}$ of an inch.

To raise the level, move the collar towards the point of the needle valve.

To do this grip the needle valve between two blocks of wood in a vise. Provide a piece of copper or brass tubing which can be slipped over the upper end of the valve and against the top of the collar. Tap lightly on this tube to move the collar and be very careful not to mar or bend the needle valve.

Never bend the lever weights to change the level, and do not put additional gaskets under the needle valve seat.

Before reassembling the float chamber cover, see that the counterweight levers swing freely and do not bind in the needle valve collar.

How to Remove the Idling Jet—Model O-4 Carburetor

Remove the carburetor from the motor.

Remove the set screw from the carburetor body that holds the idling jet in place.

Remove lower plug under compensating jet.

Remove compensating jet.

The idling jet can now be removed.

Occasionally a slight jar will be sufficient to remove; however, should it stick, with the use of a "priming plug puller" (Fig. 102) it can be easily removed.

How to Remove the Idling Jet—Model T-4 Carburetor

Remove the carburetor from the motor.

Remove the two screws which hold the barrel to the carburetor bowl and remove the bowl.

The jet can now be removed by turning to the left.

When assembling, be sure to install the fine wire screen in place.

Carburetor Settings

When the carburetor has been disassembled for repairs or cleaning, note the settings and be sure the correct size jets are installed according to factory specifications.

Two type carburetors have been used which are known as the Model O4 and T4 Zenith, except on the Superior Model which is equipped with T4X type Zenith.

The carburetor jets which we find to give the best results are as follows:

Model	Carburetor Model	Choke	Main Jet	Compensator	Idling Jet	Needle Valve Seat
490	O-4	19	90	95	40	44
Superior	T-4-X	19	18	18	40	44
490-G	T-4	19	17	18	40	44
FA	O-4	21	95	100	40	44
FB	O-4	21	95	100	40	44
FB	T-4	21	19	20	45	38
T		21	95	110	45	38

The readings on Model T-4 carburetor, main and compensator jets, can be multiplied by five to determine the comparison with jets used in Model O-4 carburetor.

Carburetor (Holly)

The adjustments on the Holly carburetor are so locked that they cannot change of themselves; faulty operation is usually caused by dirt or water interfering with the proper flow of fuel through the carburetor. To the extreme left of the float chamber bowl is the fuel entrance and the strainer body which is connected to the vacuum tank. Before the gasoline enters the float chamber, it must pass

through a filter screen. This screen may be easily removed by unscrewing the strainer screen screw.

To properly clean the screen, it should be washed in a bowl of gasoline. This should be done at least every 2,000 miles.

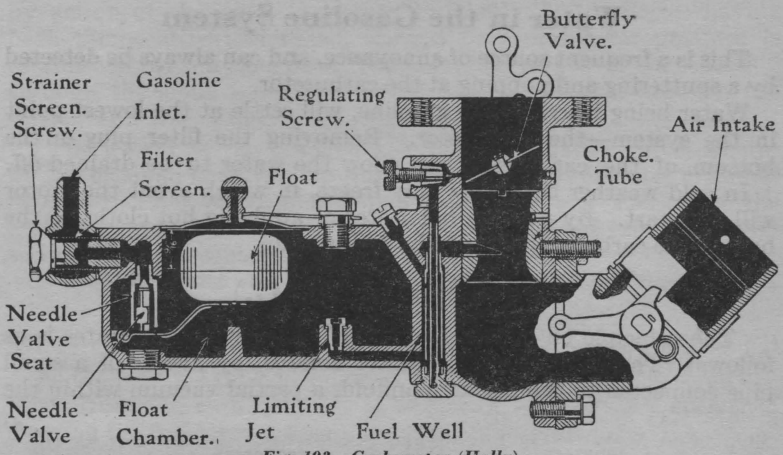


Fig. 103—Carburetor (Holly)

Throttle and Idle Adjustments

The idling adjustment is controlled by the regulating screw with a knurled head—turning clockwise gives less fuel, turning counter-clockwise gives more fuel for idle.

Throttle Adjusting Screw

The throttle adjusting screw prevents the complete closing of the throttle valve. When idling, if the throttle valve is allowed to shut off too far, the motor speed will be too slow and similarly, if the valve is opened too far, the speed will be much too fast. The size of the opening of the valve is controlled by the adjusting screw. This screw is clearly shown in the cut and is located on the engine side of the carburetor. If this throttle adjusting screw turns too tightly, first loosen the lock screw, making sure to tighten the lock screw after the proper adjustment is secured. Turning the adjusting screw counter-clockwise reduces the idling speed of the engine and turning the screw clockwise will increase the idling speed of the engine.

Main or Running Adjustment

All the fuel passing to the main nozzle and also to the idling nozzle is metered by the limiting jet, which is a fixed adjustment. If dirt collects over this jet the float must be removed in order to take this jet out for cleaning.

In very warm climates or in hot summer months, it may be necessary to open the cool air vent in the air intake sleeve on the carburetor, as the excessive heat drawn through the intake does not form a perfect mixture. It also adds to the heat of the motor.

Water in the Gasoline System

This is a frequent source of annoyance, and can always be detected by a sputtering and popping at the carburetor.

Water being heavier than gasoline, will settle at the lowest point in the system—the carburetor. Removing the filter plug on the bottom of the carburetor, will allow the water to be drained off.

In cold weather the water may freeze, in which event the motor will not start. By pouring hot water or applying hot cloths to the base of the carburetor this can be loosened up.

Fuel System (G. G.)

The principle on which the "G. G." Fuel System operates is as follows: The rotation of the motor creates, by means of a small pipe connected to the intake manifold, a partial vacuum within the

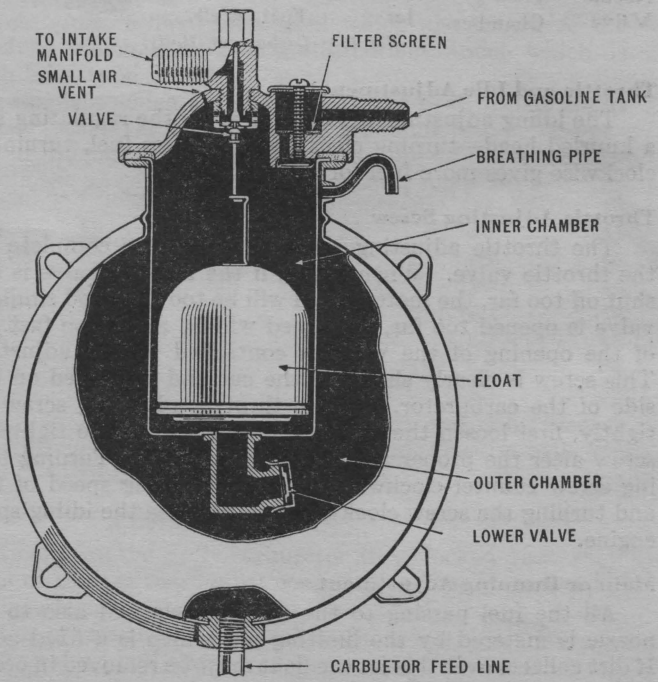


Fig. 104—Fuel System

inner chamber, which is communicated through the vacuum feed to the gasoline tank in the rear of car. This causes the fuel to be forced by suction into the inner chamber of the vacuum system. When the gas reaches the level, the valve is automatically closed by action of the float, thus the "Suction" of the motor, having been temporarily eliminated, normal or atmospheric pressure is established within the inner chamber, by means of air entering through the small permanent vent, which is located between the screen, and the outlet to the manifold.

The weight of the gasoline now opens the lower valve, whereby the gasoline flows rapidly from the inner into the outer chamber of storage reservoir, which is independent of any suction of the motor, and functions simply as a storage tank supplying gasoline by gravity to the carburetor.

Vacuum Tank

Models Four-Ninety, Superior Sedan and Coupe, FA and FB

As the gasoline tank is mounted on the rear of the car, some distance from the carburetor, it is necessary to provide a means of drawing the fuel from the tank into the carburetor.

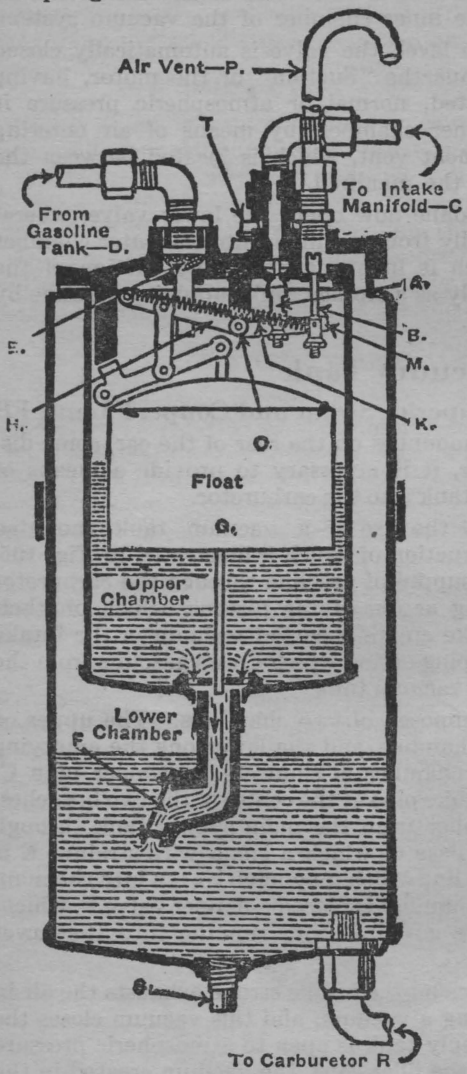
This is accomplished by the use of a vacuum tank mounted under the hood, the construction of which is illustrated in Fig. 105.

Every motor draws its supply of gasoline through the carburetor by reason of the pumping action of the pistons, which on their downward or suction stroke create a partial vacuum in the intake pipe. It is this same pumping action which draws gasoline from the main supply tank into the vacuum tank.

The vacuum tank is composed of two chambers. The upper or smaller one is the filling chamber, and the lower one the emptying chamber. To the upper chamber is connected a copper pipe C, which is attached to the intake pipe at the center of the two branches. Gasoline enters this chamber from the main supply tank through the connection D, at the base of which a small wire strainer E is placed to catch any dirt or lint which may have gotten into the main tank. At the base of this chamber is placed a flapper valve F, which, when closed, prevents the gasoline from running into the lower chamber.

The suction of the pistons on the intake stroke exhausts the air in the upper chamber, creating a vacuum, and this vacuum closes the valve F. As the main supply tank is open to atmospheric pressure (through the vent hole in the filler cap), the vacuum created in the upper chamber will cause the gasoline to flow from the main tank through the supply line and into the chamber through the connection D. Mounted inside of this chamber is a metal float G, and as the gasoline rises in the chamber the lever H moves upward until

when the proper quantity has been obtained the direction of pull on the springs K is reversed, which causes the lever M to move upward. This action closes the valve A, thus shutting off the suction from the motor, and opens the valve B, which allows air to flow into the chamber through the vent pipe P.



No. 105—Vacuum Tank

The admission of outside air destroys the vacuum in the chamber, which automatically releases the suction on the valve F and at the same time stops the flow of gasoline through the pipe D. The weight of the gasoline in the upper chamber then causes the valve F to open, allowing the gasoline to flow into the lower chamber, from whence it flows by gravity to the carburetor through the connection R.

As the level of the gasoline in the upper chamber drops, the float G moves downward, causing the lever H to move at its free end in the same direction. The levers H and M are pivoted on the pin O and connected together at their free ends by springs K; therefore, when the free end of lever H has dropped below the center line of the pivot O the direction of pull on the springs K will reverse, and the lever M will move downward at its free end. This action opens the valve A, thus permitting the motor suction to create a vacuum in the upper chamber and start the flow of gasoline

through the connection D, and at the same time closes the valve B, shutting off the admission of outside air. The process of filling the upper chamber is then repeated.

As all lint and dirt cannot be kept out of the system, it is necessary to drain the lower chamber every three months, and to do this a drain plug S is placed at the lowest point in the tank.

The manufacturers of the vacuum tank maintain a complete service repair organization in all principal cities, and we recommend that should trouble be encountered with this system you consult one of their experts or write the factory direct.

Should this be impossible, the following instructions supplied by the manufacturers, if carefully followed, should give relief.

Care and Repair of Vacuum System

Before proceeding to repair the vacuum tank make absolutely sure that the trouble is not due to some other cause.

Vent Tube Overflows

The air vent P allows an atmospheric condition to be maintained in the lower chamber, and also serves to prevent an overflow of gasoline in descending steep grades. If once in a long while a small amount of gasoline escapes no harm will be done, and no adjustment is needed.

However, if the vent tube regularly overflows, the air hole in main gasoline tank filler cap may be too small, or may be stopped up. If the hole is too small, or if there is no hole at all, the system will not work. Enlarge hole to $\frac{1}{8}$ in. diameter, or clean it out.

Failure to Feed Gasoline to Carburetor

Remember that this condition may be due to other causes than the vacuum system. Do not blame the vacuum system until you are sure that the fault does not lie elsewhere. After flooding the carburetor, or "tickling the carburetor," as it is commonly called, if gasoline runs out of the carburetor float chamber you may be sure that the vacuum feed is performing its work of feeding the gasoline to carburetor.

Another test is to take out the inner vacuum tank, leaving only the outer shell. If you fill this shell with gasoline and the motor still refuses to run properly, then the fault clearly lies elsewhere, and not with the vacuum system—because you must certainly get gasoline feed from this open elevated tank of gasoline, unless there is stoppage in the connection line to carburetor.

To Remove Top

In removing top of tank, after taking out screws, run the blade of a knife carefully around top, between cover and body of tank, so as to separate gasket without damaging it. Gasket is shellaced to make an air-tight joint.

If Faulty Feed is Traced to Vacuum System, One of the Following Conditions May Be the Cause

(A) The float, which should be air-tight, may have developed a leak, thus filling up float with gasoline and making it too heavy to rise sufficiently to close vacuum valve. This allows gasoline to be drawn into manifold, which in turn will choke down the motor. Proper operation depends upon the float being air-tight.

To Repair Float

Remove top of tank (to which float is attached) as above directed. Dip the float into a pan of hot water, in order to find out definitely where the leak is. Bubbles will be seen at point where leak occurs. Mark this spot.

Next, punch two small holes, one in the top and the other in the bottom of the float, to permit discharge of the gasoline. Then solder up these holes and the leak. Test the float by dipping in hot water. If no bubbles are seen, the float is air-tight.

In soldering float, be careful not to use more solder than required. Any unnecessary amount of solder will make the float too heavy.

In taking out float and repairing it, take care not to bend the float guide rod. If you do bend the rod it will strike against guide and retard float, producing the same effect as a leaky float, and allowing gasoline to enter manifold. Also note whether surface of rod is perfectly smooth, so that it cannot be retarded by guide.

To overcome the condition of a leaky float temporarily until you can reach a garage, remove plug T at the top. In some cases the suction of the motor is sufficient to draw gasoline into tank even with this plug open, but not enough to continue to be drawn into manifold. If, however, you are not able to do this, close up plug T with engine running. This will fill tank. After running engine until tank is full, remove plug T until gasoline gives out. Repeat the same operations until a repair station or garage is reached, where the leaky float can be remedied.

(B) The flapper valve F may be out of commission.

A small particle of dirt getting under the flapper valve might prevent it from seating absolutely air-tight, and thereby render the tank inoperative.

In order to determine whether or not the flapper valve is out of commission, first plug up air vent; then detach tubing from bottom of tank to carburetor. Start motor and apply finger to this opening. If suction is felt continuously, then it is evident that there is a leak in the connection between the tank and the main gasoline supply, or else the flapper valve is being held off its seat and is letting air into the tank instead of drawing gasoline.

In many cases this troublesome condition of the flapper valve can be remedied by merely tapping the side of the tank, thus shaking loose the particle of dirt or lint which has clogged the valve. If this does not prove effective, remove tank cover, as described on previous page. Then lift out the inner tank. The flapper valve will be found screwed into the bottom of this inner tank.

(C) Manifold connection C may be loose, allowing air to be drawn into manifold.

(D) Tubing may have become stopped up in lengths B or C.

(E) Gasoline strainer E is a screen located in the line from gasoline tank. This screen collects all foreign substances that might get in the rear tank, and be carried through to the carburetor and clog it. If tank fails to work it may be that this screen is clogged, preventing gasoline from getting into tank. Screen may be easily cleaned by unfastening connection at elbow. This cleaning should be done every three weeks. If tank should ever fail to operate examine strainer first.

Carburetor Trouble

(A) Carburetor trouble cannot possibly be attributed to vacuum system. If gasoline is delivered to carburetor, vacuum feed has done its work.

(B) If carburetor pops and spits, carburetor adjustment is needed.

(C) If car slows down, or if you cannot get usual speed out of car while running with open throttle, although the car still continues to run, you may be sure the trouble is not due to vacuum system. If all the gasoline in vacuum tank is exhausted the car will stop.

Filling Up Tank in Starting

To fill the tank, should it ever become entirely empty, with the engine throttle closed and the spark off, turn the engine over a few revolutions. This takes less than ten seconds, and will create sufficient vacuum in the tank to fill it. If the tank has been allowed to stand empty for a considerable time, and it does not easily fill when the engine is turned over, this may be caused by dirt or sediment being under the flapper valve F. Or perhaps the valves are dry. Removing the plug T in the top and squirting a little gasoline into the tank will wash the dirt from this valve and also wet the valves and cause the tank to work immediately. The flapper valve sometimes gets a black carbon pitting on it which may tend to hold it from being sucked tight on its seat. In this case the valve should be scraped with a knife.

Connections and Tubing

Look over the connections to see that they are absolutely tight. Coupling and elbow connections should be always screwed down tight. Care should be taken that tubing contains no sharp, flat bends that might retard gasoline flow.

Suction valve A, also atmospheric valve B, can be easily ground if it ever becomes necessary. However, the fact that these two valves are not required to seat against a pressure, but are drawn on to their seat, eliminates the probability of their needing to be ground.

Clean Tank Every Three Months

(To clean tank: Don't take tank off car; you may not be able to put it back in exactly the same position.)

Unless gasoline is filtered through a screen of chamois when filling the main gasoline tank, from which the vacuum tank draws its supply, some dirt or sediment will accumulate in main tank. Part of this dirt or sediment may be drawn into the vacuum tank. This dirt should be removed from the vacuum tank at least once every three months. To clean the tank, remove the top and take out the inner shell or vacuum chamber. (Be careful to observe instructions "to remove top.") This will give access to the lower chamber, from which the dirt and sediment should be removed.

If you find it necessary to send the tank to us, ship the complete tank to our nearest branch or service station.

Electrical System

Electric Starting and Lighting System

The system used is known as the two-unit type; that is, with a separate generator and starting motor, each performing its function independently of the other.

The system, as a whole, comprises three principal units:

The generator, which produces an electric current and delivers it to the storage battery.

The storage battery, which receives and accumulates the current thus generated, and delivers it to the igniter, lighting system or the starting motor when needed.

The starting motor receives the current from the storage battery and cranks the automobile motor whenever it is to be set in motion.

In addition there are four auxiliary systems for the regulation and control of the different units, as follows:

A circuit breaker, whose function is to "break" the charging circuit when the automobile engine is standing still or when the speed drops below the point where a generator will produce a charging voltage and also connects the charging circuit when the output of generator is strong enough to charge battery.

An ammeter, which registers on a dial the charging or discharging rate of current flowing through the system. When the car is at rest and no lights burning, the indicating needle or pointer should stand at "zero." When the lights are turned "on," the pointer will move to the right, and indicate the amount of discharge or current flowing from the storage battery. With the automobile motor running at a fair speed, and no lights burning, the pointer will move to the left of zero, and indicate the amount of current flowing into the storage battery, or "charging rate." Should the pointer indicate "discharge" when the car is at rest and no lights burning, the system is not working properly, and should be investigated to determine the cause of the trouble as quickly as possible.

A starting switch, the function of which is to make the necessary electrical connection from the storage battery to the starting motor when the automobile motor is to be set in motion. This switch is self-contained in an insulated steel box and requires no attention except to keep terminals tight.

An ignition and lighting switch, by which the ignition and lighting systems are controlled.

Generator and Ignition Set

Fig. 106 illustrates the relative position of the generator and ignition sets for the various models, and show the points to lubricate. The units on Models Four-Ninety, Superior, G, FA, FB, T, are mounted on the right side, at the front of the motor. The

generator is driven by a gear which meshes with the cam shaft gear. The ignition coil is mounted on top of the generator, and the igniter or distributor is driven by the generator armature shaft.

The Generator

The construction of the generator is of the utmost simplicity, and beyond a few drops of oil every 500 miles requires no attention. The machine is inclosed in a dust and moisture proof shell which effectually protects it from oil and dirt. The generator is driven by a gear meshing with the cam-shaft gear housed in the gear case at the forward end of the automobile motor. The voltage output is controlled by a third brush, which increases or decreases the field strength in proportion to the motor speed, thus doing away with mechanical governors and clutches, which are liable to get out of adjustment.

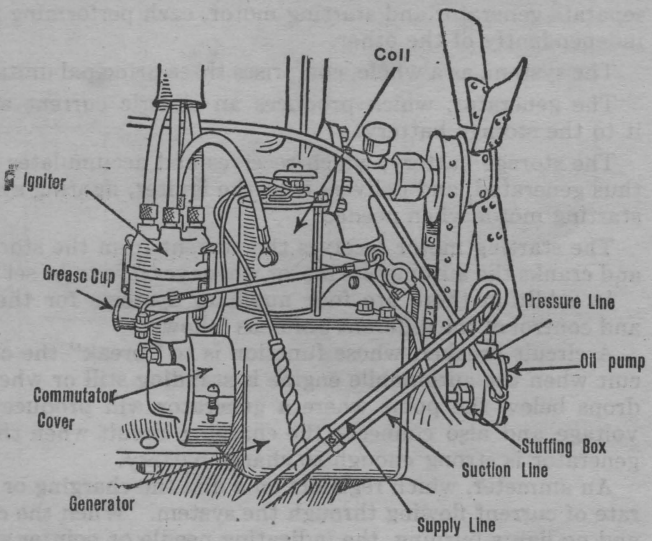


Fig. 106—Generator (Square Type) and ignition set.

The generator begins to produce a charging current of sufficient voltage at a car speed of about ten miles per hour. At twenty-five miles per hour the generator is producing nearly its maximum output, or about fifteen amperes.

Care of the Generator

The generator should be examined occasionally to see that all connections are tight and that there is no undue wear on the moving parts. The commutator end of the generator can be reached by removing the steel band around the commutator head. (Figs. 106 and 107.)

If the commutator should be found blackened or rough it may be smoothed down with No. 00 sandpaper, while the generator is running. Never use emery cloth for this purpose.

After smoothing down the commutator examine it carefully and remove all particles of metal which may bridge across from one

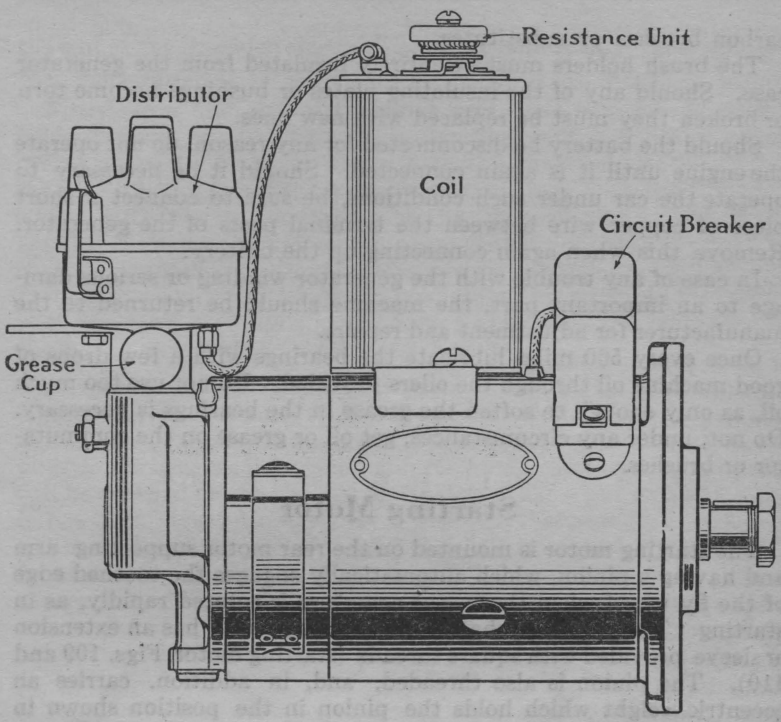


Fig. 107—Generator (Round Type) and Ignitor Set

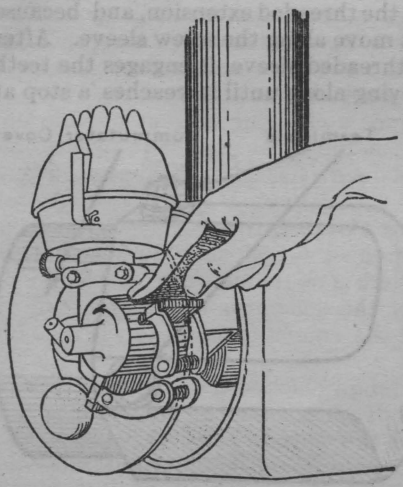


Fig. 108—Cleaning Commutator.

copper segment to another. Blow out every particle of carbon dust which may have accumulated in the generator case.

See that there is just enough spring tension on the carbon brushes to insure good contact on the commutator. Too much tension will cause heating and unnecessary wear to brushes and commutator segments.

See that the brushes are making even contact with the commutator. When they become worn to such an extent as to need replacement order new ones from the nearest Chevrolet branch. Do not use cheap

carbon brushes or substitutes.

The brush holders must be entirely insulated from the generator case. Should any of the insulating plates or bushings become torn or broken they must be replaced with new ones.

Should the battery be disconnected for any reason, do not operate the engine until it is again connected. Should it be necessary to operate the car under such conditions, be sure to connect a short piece of copper wire between the terminal posts of the generator. Remove this when again connecting up the battery.

In case of any trouble with the generator winding or serious damage to an important part, the machine should be returned to the manufacturer for adjustment and repairs.

Once every 500 miles lubricate the bearings with a few drops of good machine oil through the oilers provided. Do not use too much oil, as only enough to soften the grease in the bearings is necessary. Do not, under any circumstances, get oil or grease on the commutator or brushes.

Starting Motor

The starting motor is mounted on the rear motor supporting arm and having a pinion, which automatically engages the toothed edge of the fly wheel when the motor armature is rotated rapidly, as in starting. The armature shaft of the starting motor has an extension or sleeve provided with square threads (starting motor, Figs. 109 and 110). The pinion is also threaded, and, in addition, carries an eccentric weight which holds the pinion in the position shown in (Figs. 109 and 110) with the weight underneath. Because of the weight, the pinion is too heavy to turn on the threaded extension, and because the pinion does not turn, it must move along the screw sleeve. After the pinion has moved along the threaded sleeve, it engages the teeth on the flywheel and keeps on moving along until it reaches a stop at

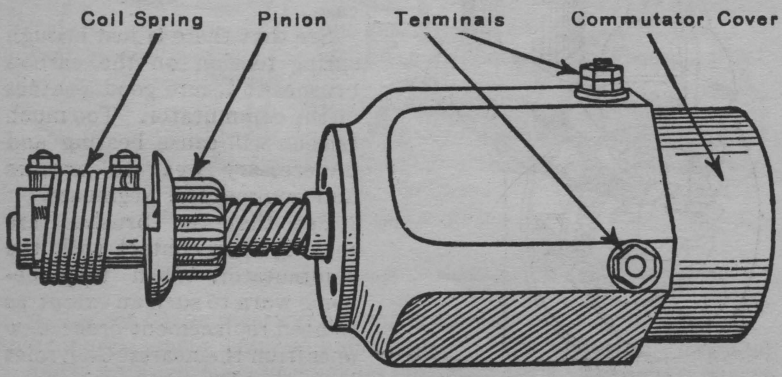


Fig. 109—Starting motor (Square Type).

the end of the threaded sleeve. The pinion and the fly wheel gear are then fully meshed.

Fitted over the end of the armature shaft is a second sleeve, held securely to the shaft by a clamping bolt. A heavy coiled spring connects the outer sleeve with the threaded sleeve. After the pinion has reached the stop, it now must turn with the threaded sleeve, but since it is engaged with the flywheel gear the shock of starting the engine would be very great were it not that the armature shaft is connected to the threaded sleeve through the coil spring. Instead of picking up the load immediately, this spring keeps coiling until the torque of the starting motor overcomes the resistance of the engine and starts to revolve the flywheel.

As soon as the gasoline engine starts under its own power, the flywheel revolves at a much higher speed than it did when the starting motor was cranking the engine. This increases the speed of the pinion, but because it is running faster than the threaded sleeve, it will be screwed on the threads of the sleeve, like a nut on a bolt, until it has been screwed out of mesh with the flywheel gear. Should the operator of the car, through error, not immediately remove his foot from the starting button, the unbalanced weight of the pinion causes it to twist on the threaded sleeve and clutch the threads, preventing it from again meshing with the fly wheel gear. This demeshing movement and clutching action is entirely automatic.

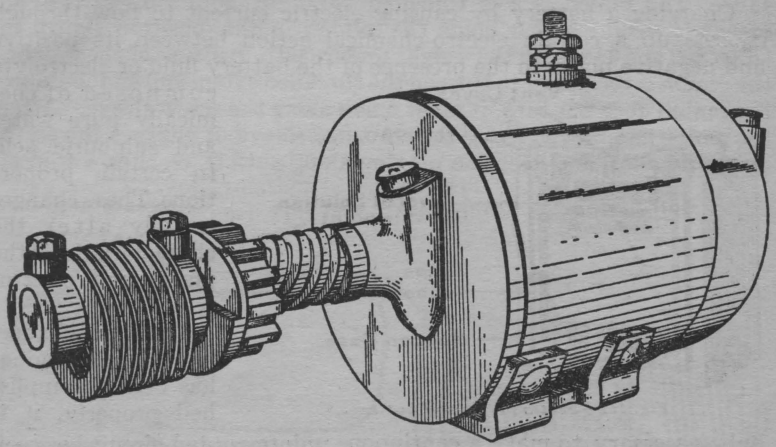


Fig. 110—Starting Motor (Round Type)

The coiled spring should be examined occasionally to see that it is clamped tightly and that no distortion has taken place. Should this occur, replace the spring, as this must be in good working order to prevent damage to the teeth on the flywheel gear.

While the coiled spring absorbs much of the starting torque, the vibration of the car, coupled with the shock of starting, may cause the clamping bolts, holding the starting motor to the motor support, to loosen and possibly shift the starting motor slightly, throwing the pinion out of proper alignment with the fly wheel gear.

Whenever, starting the engine, the pinion goes into mesh with a "bang," accompanied with considerable noise while cranking, have the bolts examined and the starting motor lined up properly. By turning the threaded sleeve with the fingers, the pinion can be moved into mesh with the flywheel gear, and any disalignment observed and corrected.

In general, the instructions given for the care of the generator will apply as well to the starting motor. The brushes and commutator are easily accessible for examination by removing the sheet metal cover on the commutator end of the machine.

Storage Battery

The battery, popularly referred to as "storage battery" which gives rise to a false conception of the true nature of the battery, is in reality an electro-chemical apparatus or machine.

Electricity is not stored away in a battery until needed, but is caused to flow into the battery and out of it by means of two wires attached to it, but none of the electricity stays there; certain changes merely take place within the battery itself.

Charging a battery by causing electric current to flow through it, sets up a certain electro-chemical action between its positive and negative plates in the presence of the battery fluid or electrolyte composed of chemically pure water and sulphuric acid in certain proportions. These changes entirely alter the characteristics of the plates and electrolyte.

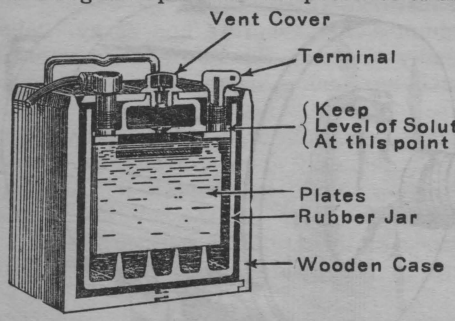


Fig. 111—Sectional view of battery.

When this change, known as charging, has been accomplished properly, it is only necessary to make a continuous uninterrupted circuit between the positive and negative terminals of the battery through the wiring system and electrical apparatus of the car in order to produce electricity.

When a battery is used to produce electricity, the charging process is reversed and in doing so the battery generates electricity,

and when used for a sufficient length of time it is restored or changed to its original or uncharged condition. Electric current is generated in the battery in as full a sense as it is in an electric generator.

From the foregoing it will be seen that the efficiency of the battery is in direct proportion to its state of charge; also that to obtain the fullest efficiency, whatever amount of current is withdrawn or generated by the battery must be compensated for by running the generator long enough to restore the battery plates to the condition known as "charged." On account of certain losses this current sent back through the battery in charging must be of a slightly greater amount than the current which was generated and put out by the battery.

If a comparatively few rules are followed out carefully in the care of the battery, the battery will continue to perform its part faithfully and have a long life.

A battery possesses three compartments or cells. Within each cell are two elements, one positive (+), and the other negative (—). Each element consists of a number of plates called "grids," the openings of which are filled with a lead paste. Each group of plates is connected together and separated from the opposite group by separators between each plate.

The liquid in which these plates are immersed is called electrolyte (3 parts distilled water to 1 part chemically pure sulphuric acid). When battery is fully charged the acid is forced out of the plates and causes the specific gravity of the solution to rise. When the battery discharges, the acid returns into the plates and the specific gravity falls, until in the case of a completely discharged battery, the solution is practically distilled water.

The battery while undergoing a charge emits a fine spray, called "gasing," composed principally of water. Therefore, it is essential that distilled water be added every week in warm weather and every two weeks in cold weather to replace this loss.

At the top of each cell is a vent hole or opening, accessible by unscrewing the vent cover. Immediately upon receipt of a battery or a new automobile the battery should be inspected. All vent covers should be removed, and the level of the solution in each cell ascertained. The battery plates should be well covered with solution, and if it is not up to the inside cover (Fig. 111), add distilled water.

Filling one cell does not fill all, so examine each one and fill as required. If inconvenient to obtain distilled water, use melted artificial ice or rain water that has been caught in a wooden tub (not metal). Under no circumstances use ordinary water. Do not store water for batteries in metallic vessels—use glass. Remember that if the battery plates are exposed (not covered by the liquid) they become hardened and the battery capacity is greatly reduced.

Never add acid, except to replace spilled solution. In that case

one part of chemically pure sulphuric acid and three parts of pure distilled water by volume.

Proper Battery Care

When a new car is purchased, the owner should go to the nearest authorized battery Service Station of the manufacturer immediately and have the battery registered in order to take advantage of their 90-day insurance policy. Also ask for a service card on which the registration date will be written.

If a battery is purchased to replace the one now in the car, it will be registered when sold.

If the car is not new advise the owner to call at an authorized battery Service Station and get a consulting service card which will entitle him without charge, to testing and filling service twice a month. At the same time he will be given advice which will help him to get the best possible service from his battery.

Test all cells with a hydrometer on the first and fifteenth of every month. If any cells are below 1.275 on two successive testing dates,

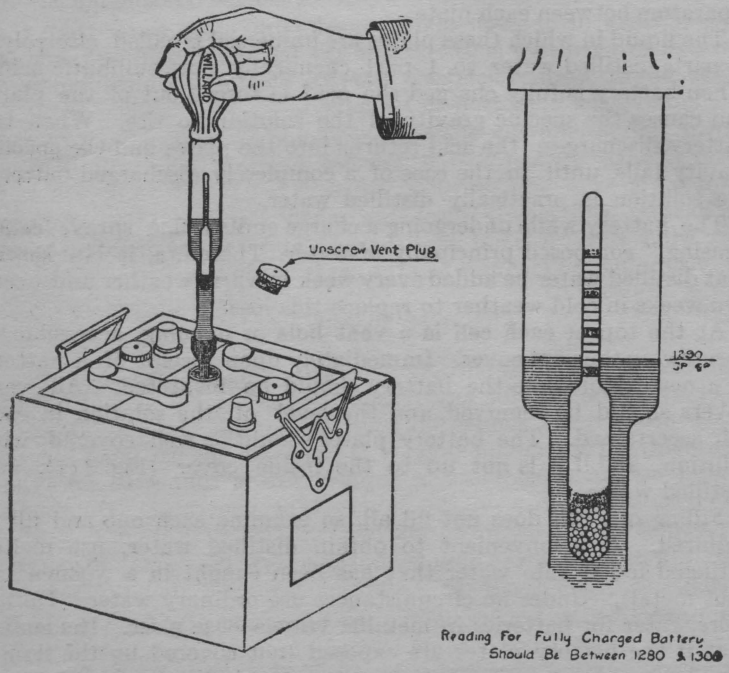


Fig. 112—Taking battery reading.

take the battery to an authorized battery Service Station and have it fully charged. In taking these readings, care should be exercised to return the electrolyte from the hydrometer syringe to the same battery cell from which it was taken.

Keep all cells filled with distilled water to a level ½ in. above the top of the plates. Never fill above this level.

Keep the battery and the battery compartment clean and dry.

Keep the terminals clean and tight and well covered with vaseline to prevent corrosion.

Never allow the battery to become heated in service above 100° F. Watch the battery for heating one or more times every day in warm weather. If the top connectors feel more than blood-warm to the touch burn all the lamps while driving, until you can consult an authorized battery Service Station, which will prescribe what is necessary. If the temperature reaches 120° F., the battery may be ruined.

In order to prevent freezing in cold weather, test the battery frequently and see that the gravity is kept up to at least 1.275. A discharged battery will freeze at a little below the freezing point.

When filling, if one cell takes considerable more water than the others, this indicates a leaky jar and the battery should be taken or sent to an authorized battery Service Station. Unless repaired immediately, the battery may be ruined.

If you lay up your car, the battery should be removed and placed in storage with an authorized Service Station, who will issue a receipt for it.

A battery will slowly discharge when standing idle. Serious injury will result if it is not kept charged, and it is not practical to do this by running the engine when the car is not in use.

Circuit Breaker

The circuit breaker is entirely automatic and requires no lubrication or attention. If for any reason the instrument should fail to operate properly, it should be returned to the manufacturer for adjustment. If the circuit breaker is removed, the car must not be operated until a short piece of copper wire is connected between the two terminal posts on the square type generator. On round type generator connect wire from positive post to ground.

Fig. 113 illustrates the circuit breaker with the metal cover removed.

Minor repairs, such as removing the burrs and pits from the contact points, which have become burned through constant use, may be done by securing a very fine jeweler's file. This file, being perfectly flat, may, without any injurious effect. be placed between the

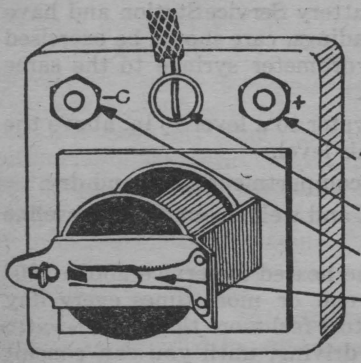


Fig. 113—Circuit breaker, cover removed.

contact points, with battery wire removed, and, with the movable points held lightly against the file, pull the file out. It may be necessary to repeat this operation several times in order to secure a perfectly flat and clean contact surface.

Do not move the file back and forth between the points as this motion has a tendency to round off the edges, causing them to have a convex surface rather than a flat surface. If the points burn off entirely or if the contact spring breaks, reinstalling new parts is the only remedy. If the coil burns out on account of the excessive flow of current through it, the only remedy is to install a new circuit breaker or return the old one to the nearest authorized Service Station for repairs.

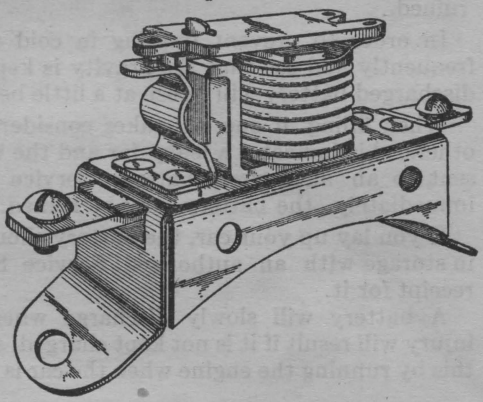


Fig. 114—Circuit Breaker for Round Type Generator

Ammeter

The ammeter is self-contained, and requires no lubrication or attention. The accuracy of its reading should be checked up occasionally to make certain that no short circuit has bent the pointer or otherwise injured its internal parts. To test for accuracy, remove the wires from the ammeter terminals or the positive (+) wire from the storage battery. The ammeter pointer should now stand at "zero," and any difference between where it actually stands and "zero" is the degree of error, and should be allowed for when observing ammeter readings.

When for any cause it is necessary to remove the ammeter and operate the car without it, the two wires which were attached to the ammeter terminals should be firmly fastened together and the bare spots covered with electrician's tape.

Lighting and Ignition Switch

Models Four-Ninety, Superior, G, FA, FB and T

The lighting and ignition switch is contained in an insulated metal case and needs no attention or adjustment. The ignition key performs the operation of turning "on" or "off" the ignition. To protect the switch from short circuits a small fuse is mounted on the back side. Should both lights and ignition fail to work examine the fuse first. It will usually be found "blown." If one or more lamps fail to burn examine the bulbs. If these are in good condition probably the switch contact springs have weakened.

Removing Distributor

Should it become necessary to remove the distributor assembly, loosen the two clamping bolts through the split collar on the generator housing and lift the entire assembly. In replacing, care should be taken to see that the shoulder on the machined end of the distributor comes in contact with the generator housing.

The clamping bolts can then be tightened securely and the advance rod connected.

Retiming Distributor

With the starting crank turn the motor until the intake valve on No. 1 cylinder has opened and closed, then remove spark plug on that cylinder and insert a screwdriver or rod. (Fig. 43.) Continue to turn the motor until the piston has traveled to its uppermost

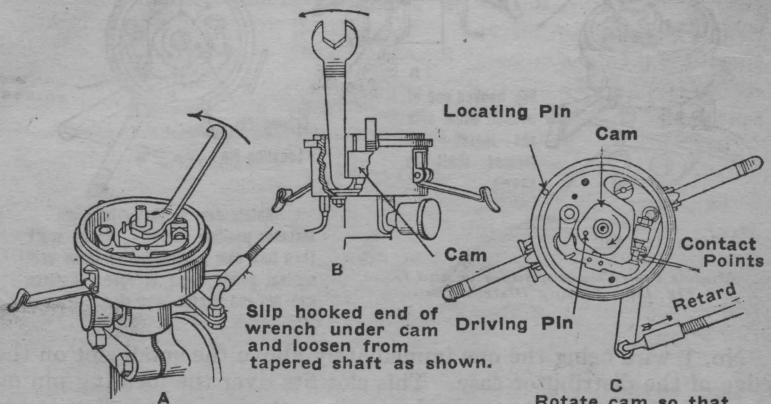


Fig. 115—Timing distributor Model FA, FB and T

position. By holding the screwdriver or rod firmly, the position at which no further upward movement takes place can be readily determined. The piston is then on "top dead center" of the compression stroke and the gases have been compressed ready for firing.

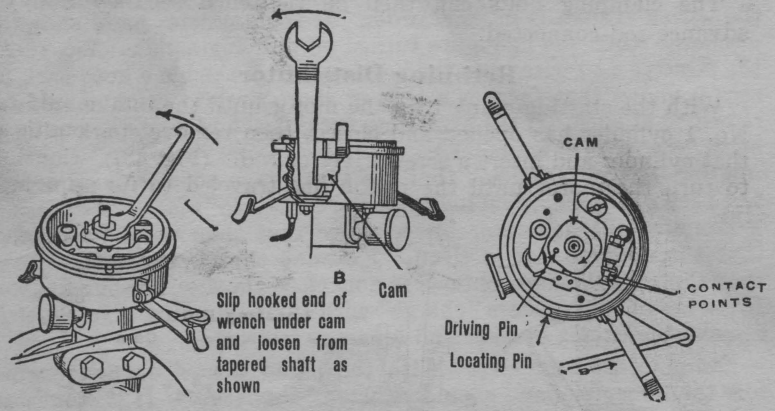
Retard the spark as far as it will go.

Loosen lock nut and raise distributor cam.

Next turn the cam on the distributor so that the driving pin assumes the position shown in Fig. 115 and 116, Sketch C, and distributor arm is directly under wire leading to No. 1 cylinder; then turn the cam in the direction of the arrow until the two contact points begin to open.

The lock nut can then be tightened against the cam; however, in doing this, use care not to disturb the position of the cam. The distributor arm and cap can now be put in place and the car operated.

On the rim of the distributor cap is a small slot which should fit over the locating pin on the rim of the distributor body. As each of the spark-plug wires is of proper length, no trouble should be experienced in attaching to their respective spark plugs.



Models Four-Ninety, Superior and G.
Fig 116—Timing Distributor

No. 1 wire being the one immediately above the small slot on the edge of the distributor case. This slot fits over the locating pin on the rim of the distributor body. The rotation of the distributor is called "clock wise;" that is, it turns in the same direction as the hands of a clock, therefore, in the same direction will come the No. 2 wire, then No. 4, and lastly No. 3.

Caution—The distributor shaft revolves at the same speed as the

cam shaft and the grease cup should be turned down often to insure proper lubrication at this point.

The igniter and distributor cap must be kept free from oil and dirt in order to insure its performing its duties properly.

Locating Electrical Troubles

When the electric system gives trouble do not jump at conclusions. Only when you have made sure that the wiring is in perfect condition, all terminals tight and connected up according to the wiring diagrams (Figs. 120 to 125), should trouble be looked for in the electrical instruments themselves.

A short circuit occurs when any two wires of opposite polarity come in contact at exposed places or with any metallic conductor. This will discharge the storage battery in a very short time, therefore, the greatest care should be taken to see that all connections remain tight and that the insulation of all wires is not broken or cut.

To prevent a short circuit from damaging the lights, a fuse is inserted in the lighting switch box. When this "blows," it can be easily replaced; however, before doing so be sure everything else in the wiring system is in good order. If the ammeter hand shows a discharge when the lights are turned off and engine idle, disconnect the positive (+) wire from the battery, and if the hand goes back to zero it shows that there is a leak or short circuit, which should be remedied at once. If the hand does not go back to zero, the needle is bent. (See care of ammeter.)

After satisfying yourself that the wiring is in good working order, test each of the electrical instruments.

Examine the generator brushes; see that they work freely and that the commutator is clean. Examine the circuit breaker; see that the points make contact; if not, close them with your fingers. If the ammeter registers "charge" with engine running at fair speed, remove the circuit breaker and repair as instructed.

Examine the ammeter. With the lights turned on and engine idle the ammeter hand should register "discharge." If it stands at zero, remove the ammeter and return to the manufacturers for repair.

Examine the storage battery. See that the solution in each cell covers the plates, and add distilled water if it does not. See that the top of the battery is clean and terminals tight. In case of leakage of the electrolyte in one or more cells, take your battery to the nearest battery service station for examination and replacements.

It should be remembered that the efficiency of any storage battery decreases with a drop in temperature, and for that reason the starting motor and lights should be used sparingly in cold weather and the engine run for several minutes at good speed after each start.

Detecting Ignition Trouble

Misfiring

Figs. 117 show the proper method to locate the particular cylinder which misfires.

With the motor running, hold a wooden-handled screw-driver so that the metal edge touches the spark plug terminal and then comes incontact with the cylinder head.

If a change in the running of the motor is noticed, that particular cylinder is running properly. If no change, however, is noticed, either the spark plug or the spark plug wire is at fault.

Remove the spark plug, and, if it is fouled with carbon, clean with gasoline and a brush.

If the porcelain insulation of the spark plug is broken, a complete new plug must be installed.

Trouble may also be caused by the spark plug points being too far apart. The proper spark gap is .020 in., or slightly less than $\frac{1}{32}$ in.

The spark gap may be changed by exerting a slight pressure upon the two points and carefully forcing them closer together; may be increased by inserting the blade of a knife, which will separate the points the desired distance.

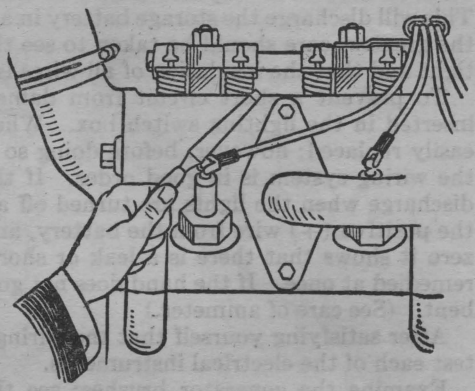


Fig. 117—Short circuiting spark plugs.

The sparking points or electrodes may have become burned to such an extent as to increase the resistance of the electric current. If this is true, the best remedy is to renew the plug.

Another method of determining the working qualities of the spark plug is to interchange the plugs which you know are good with those which appear to be poor, and by the process of elimination weed out the inferior plugs.

The trouble may be with the spark plug wire. Disconnect it from the spark plug and hold the end about $\frac{1}{4}$ in. from the plug. If no spark jumps across the gap with the motor running, examine the terminals and insulation. Frequently the stranded copper wires break which will cause an open circuit, and which is very difficult to discover.

If no exterior damage can be found, secure another piece of wire,

fastening one end on the distributor cap and holding the other end near the spark plug. With the motor running, if a spark jumps across the gap, a new spark plug wire should be installed.

Distributor

If trouble is suspected with the distributor, see if a spark is delivered to the plugs. Failing to get a spark at the plugs, disconnect the high-tension wire (running from the central terminal of the distributor to the coil) from the coil (Fig. 118),. and hold it within one-quarter inch from the point from which it was removed.

Turn the motor over by hand with the ignition switch "turned on." If no spark occurs at this point, first examine the wire to see that it is in good condition and that it is properly secured to the distributor cap.

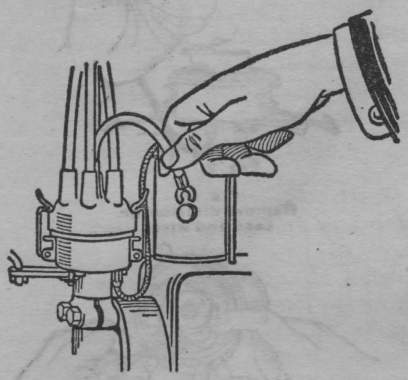


Fig. 118—Testing igniter.

After satisfying yourself that this is in proper shape, slip the distributor cap off the distributor and examine the small button-headed spring on the distributor arm (Fig. 116 C). See that this is not broken and that it is making good contact with the high-tension terminal. If this part of the assembly is in good condition some ground exists in the breaker box (Fig. 119).

Examine the primary wire, see that the insulation is good and that it is properly fastened to the distributor. Occasionally oil or grease will get into the breaker box and form a connection between the case and the insulated contact point. Wipe out thoroughly.

Contact Points

The contact points will require little attention or refiling, even though they may be very rough and irregular. When they become so badly burned as to cause missing they should be "trued" so that their contact surfaces are exactly parallel. The best way to do this is to secure a thin Swiss or jeweler's file, insert the blade between the contact points, then press them together firmly with the fingers (Fig. 119 D), at the same time withdrawing the file. Repeat this operation two or three times, then adjust the contact points so that when the cam holds them open the space between is $\frac{1}{32}$ inch.

Caution.—The contact points are made from thin disks of tungsten welded to alloy buttons, so care must be taken to remove only enough

metal (when truing points) to get parallel surfaces. When the tungsten has been removed by reason of frequent refiling, a new adjustable point and contact arm can be secured by writing us or the maker of the instrument.

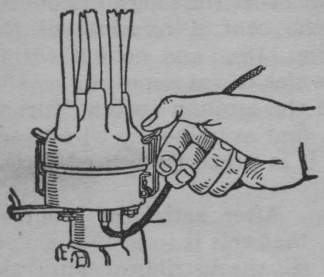


Fig. A.
Unclasp spring hinges on the sides of Igniter

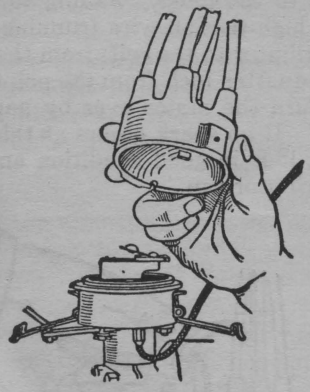


Fig. B.
Remove distributor case and wires

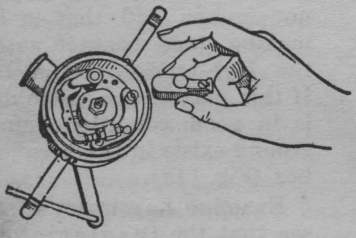


Fig. C.
Remove distributor arm

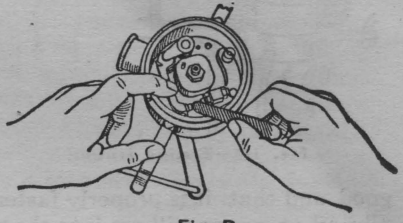


Fig. D.
Open arm and insert file between contact points

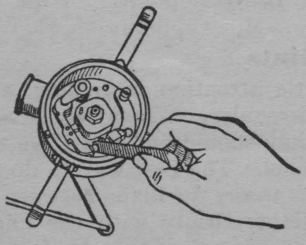


Fig. E.
Close contacts and square points by moving file up and down three or four times

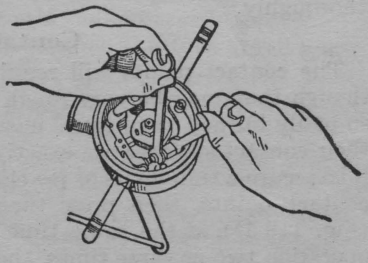


Fig. F.
Adjusting contact points

Fig. 119—Disassembling distributor

Ignition Coil

In order to test ignition coil remove Distributor Case. (Fig. 119 A-B).

Remove high tension wire (running from the side of coil to central terminal on distributor cover) from coil. Ground point of insulated handled screw driver to top of generator, bringing side of screw driver within one-quarter of an inch of the terminal on side of coil. Turn on ignition switch. Make and break contact points with finger. If spark jumps from coil to screw driver, coil is not defective. If slight spark occurs at breaker box and none from coil to screw driver, coil is defective. If no spark occurs at either place, look for trouble in ignition circuit.

Primary Circuit

When testing primary circuit there are practically only three things to be taken into consideration, namely; the condition of the breaker box, the contact points, and the wiring and ignition switch.

When tracing the primary circuit, first see if the fuse in the switch has "blown," then trace all wiring, following the diagram shown in this book (Figs. 120 to 125).

Ignition Switch

In order to test switch and determine if current flows through it insert key in switch, turn to "on" position. Ammeter on dash should show discharge. If not, disconnect wire marked ign. from ignition switch and touch on terminal marked bat. on switch. If ammeter shows discharge there is an open circuit in switch. Switch can also be tested by using a 6-volt test lamp or voltmeter connecting one side to the ground and the other to ignition terminal back of switch. Current for ignition circuit does not go through fuse.

Wiring Diagrams

Wiring diagrams for Models Four-Ninety, Superior, G, FA, FB and T are shown in (Figs. 120 to 125).

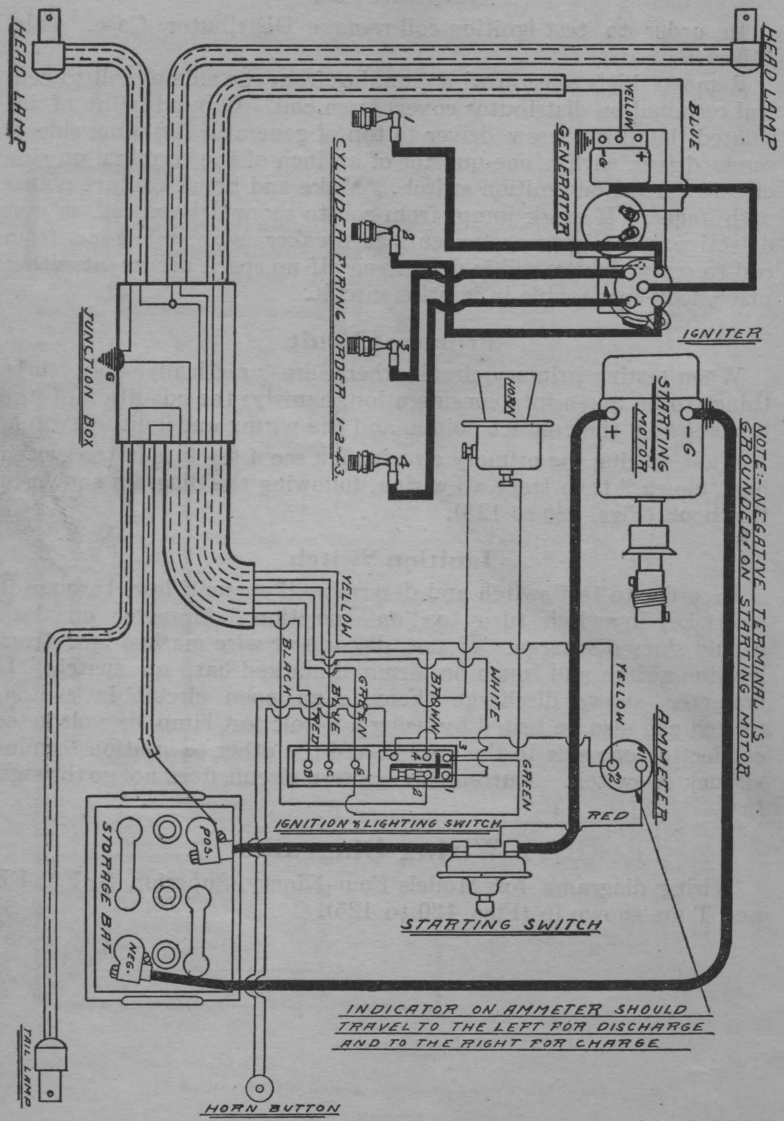


Fig. 120—Wiring Diagram of Four-Ninety
(Double contact System)

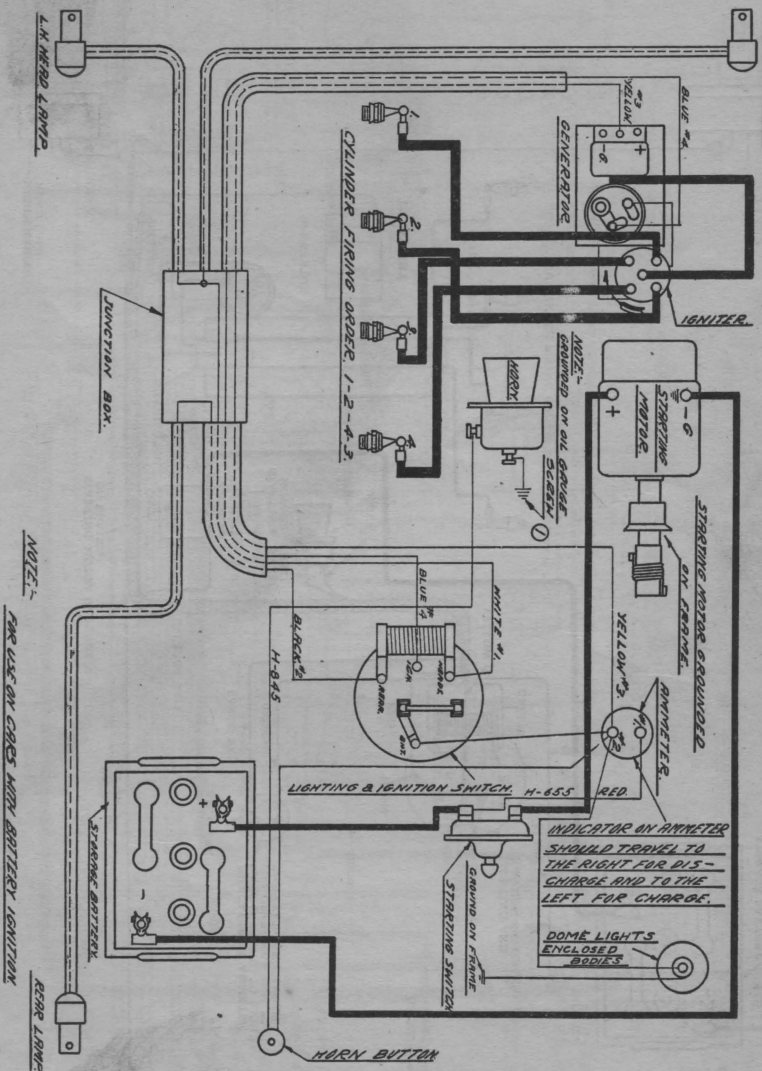


Fig. 121—Wiring diagram of Four-Ninety, and G
(Single contact system)

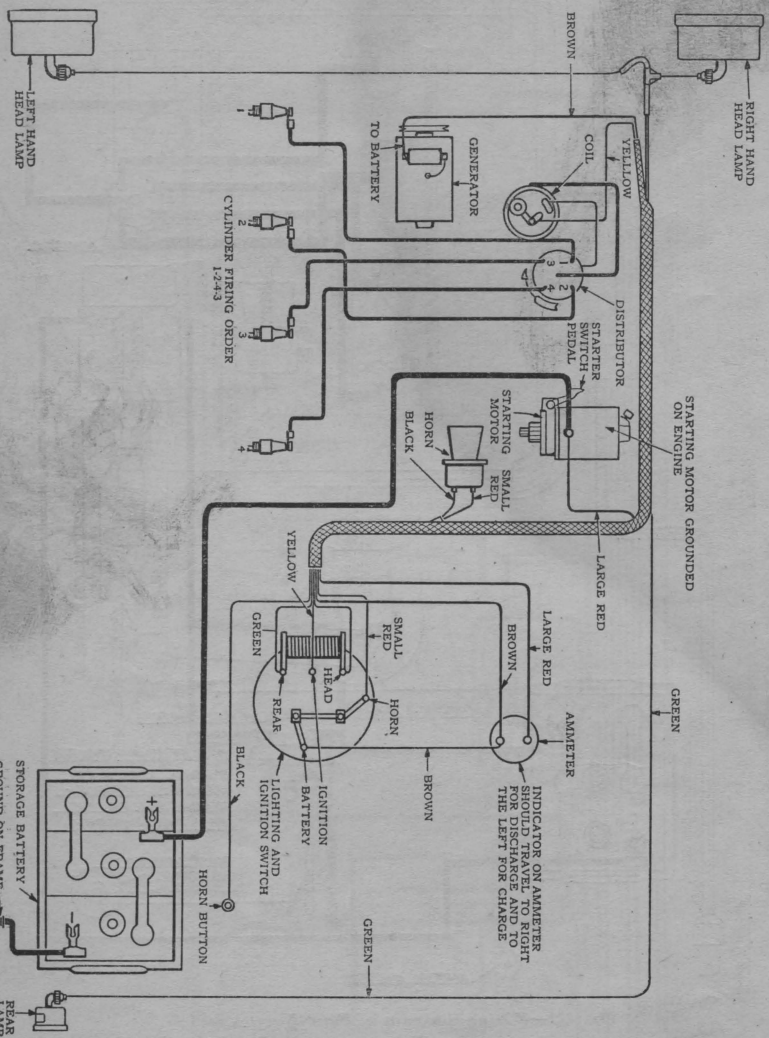


Fig. 122—Wiring Diagram, Superior Model

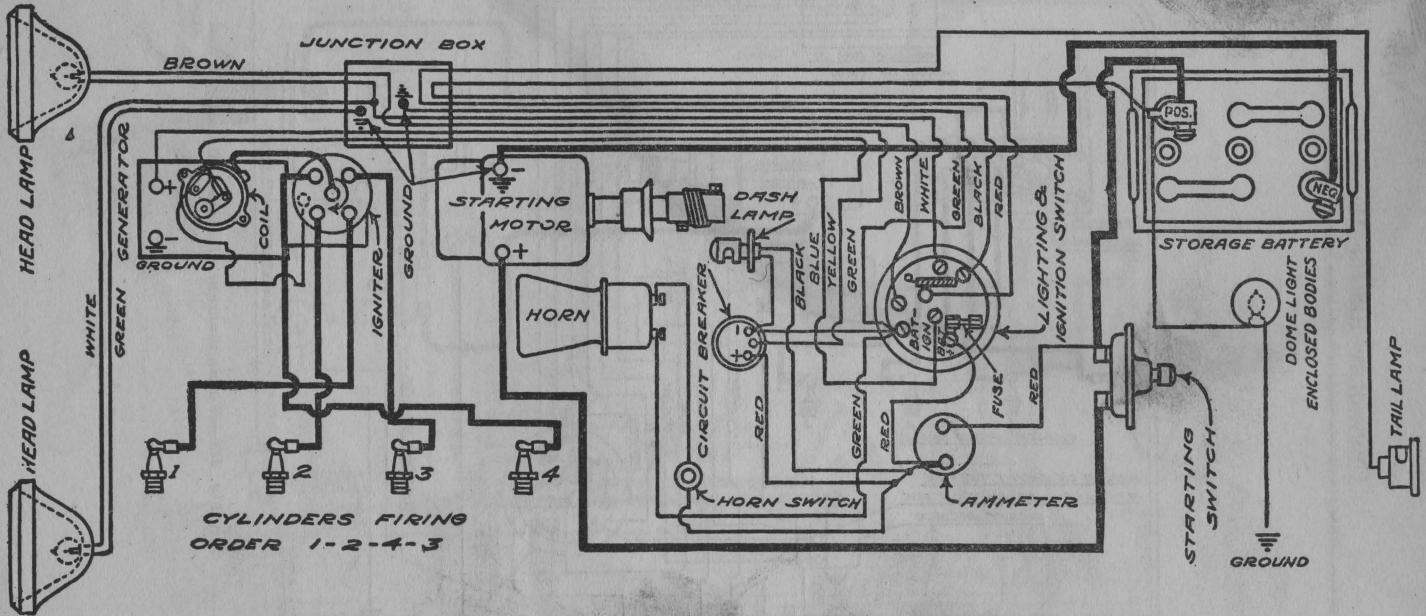


Fig. 123—Wiring diagram of Model FA cars

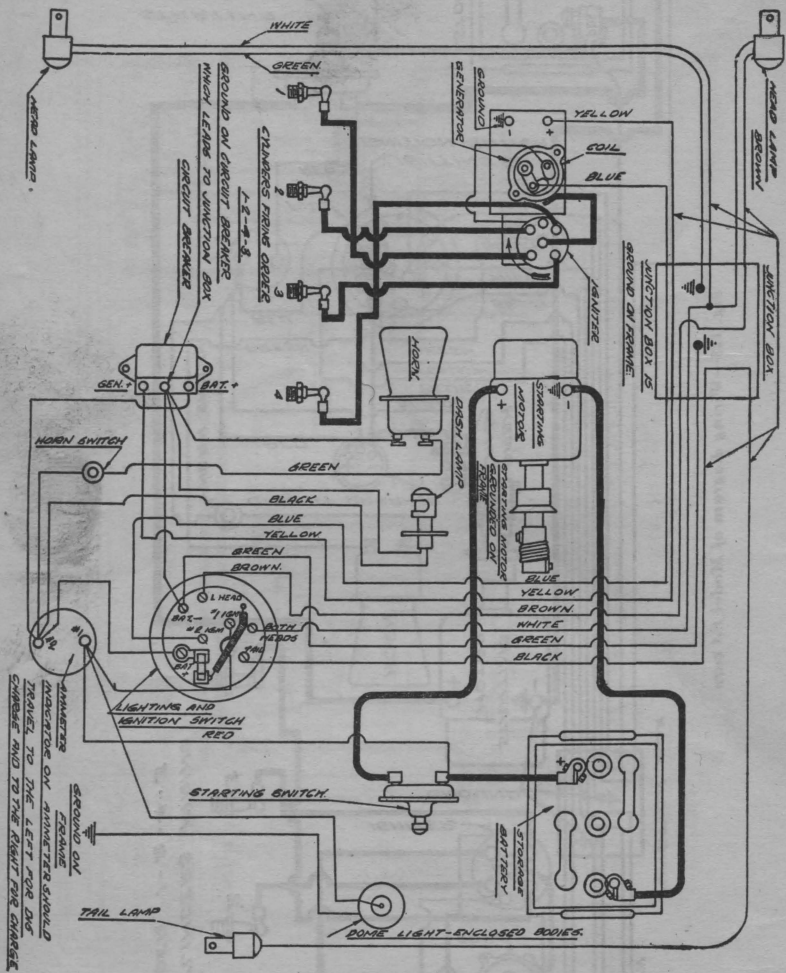


Fig. 124—Wiring diagram of Model FB cars

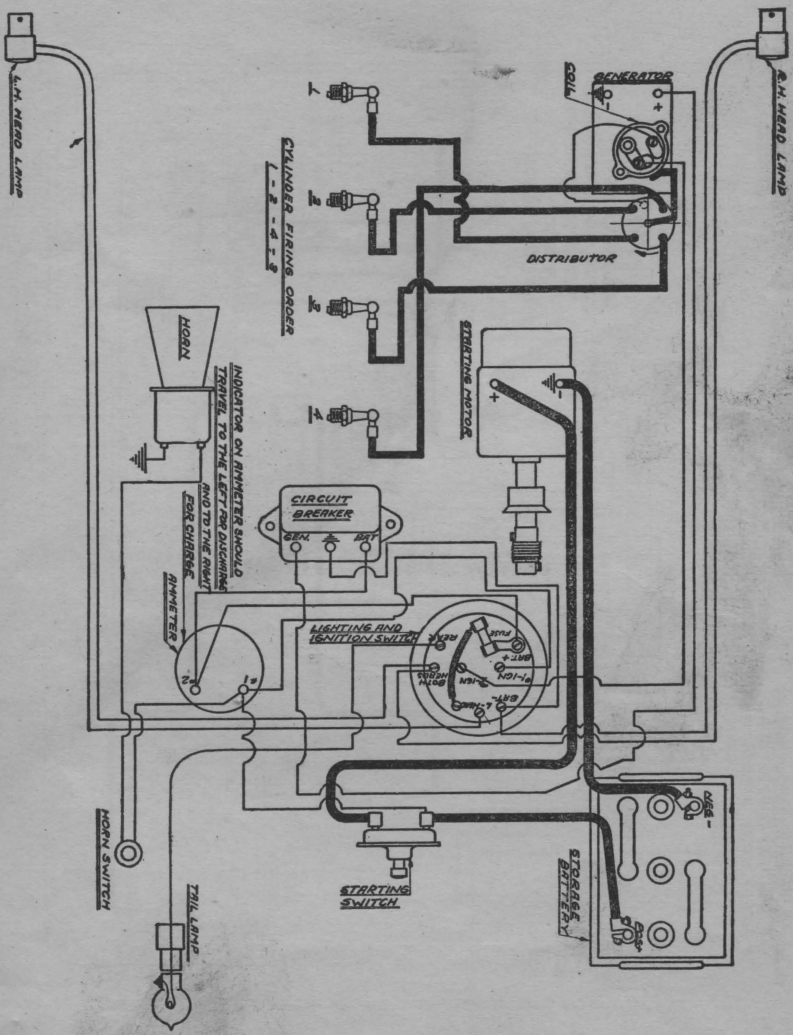
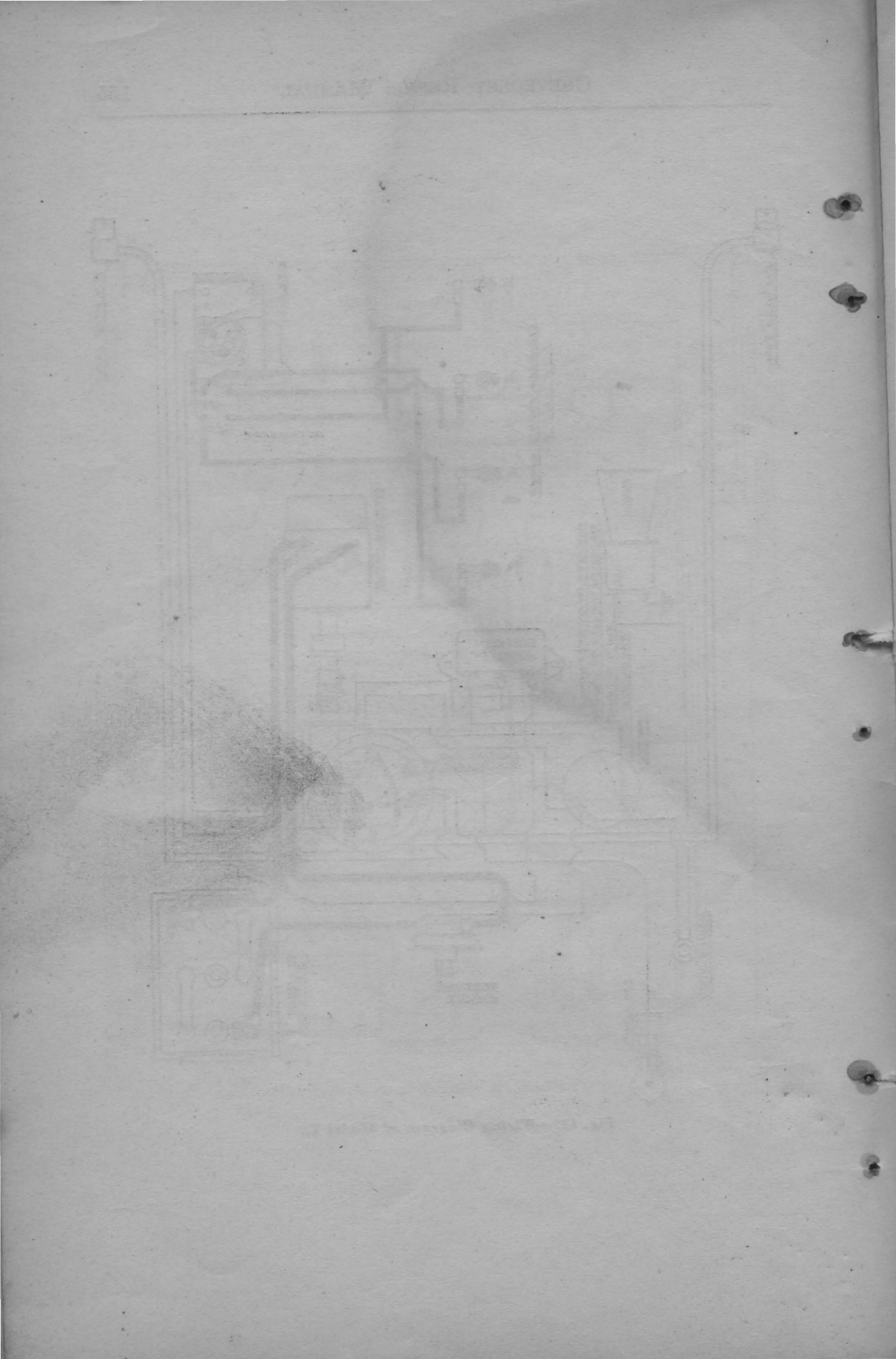


Fig. 125—Wiring Diagram of Model T.



Chapter V

◆

General Lubrication

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General Lubrication

The purpose of lubrication is to prevent any two pieces of metal that are working one against the other from touching. This is accomplished by having a film of oil between these two metals. Upon this film of oil depends entirely the life of the bearings, cylinder walls, pistons, and, in fact, all working parts of the car. Care of the lubricating system will often eliminate a great many repairs.

Motor Oiling System

The oiling system used in the Chevrolet motors is known as the constant splash system. The oil is carried in a reservoir or oil pan located at the bottom of motor and the oil is drawn from this reservoir by the gear pump located on the end of the generator shaft. It is then fed into four troughs or depressions into which the spoons or splashers on the end of the connecting rods dip. The rapid splashing of the spoons keep the main bearings, connecting rod bearings, piston pins, camshaft bearings and cylinder walls bathed in oil, from whence it drains back in the reservoir to be used over again. On the left side of the oil basin on the Model Four-Ninety, Superior, FA, G and the first 1500 Model T trucks, are two pet cocks, one above the other, to determine the amount of oil in the reservoir. Five quarts of cylinder oil, with the reservoir empty, will bring the level to the top pet cock and it is very essential that the oil never be allowed to get below the lower pet cock. On the Model FB and T there is an oil level gauge on the left side towards the front of the motor which extends to the bottom of the oil base and registers the level of oil. Six quarts of oil in an empty reservoir is sufficient to bring the level to the high mark on the level gauge and should not be allowed to get below the low mark. Always use a good medium grade of cylinder oil.

Pockets are provided in the cylinder head to contain oil to lubricate the valve stems. These pockets should be kept about one-half filled with cylinder oil.

The clutch thrust ball race on the Model Four-Ninety, Superior and G is lubricated from the motor and needs no further attention.

Lubrication of Clutch

The clutch of all models has a leather facing which should never be oiled with anything but pure "Neat's Foot" oil, which is the natural oil of the leather and can be purchased from any drug store or accessory store.

The clutch collar on the Model Four-Ninety, Superior and G should be lubricated every 250 miles (Fig. 61) with a medium heavy grade of cylinder oil.

The Model FB clutch collar is lubricated through the hollow main drive shaft from the transmission. (Refer to Page 75).

Transmission Lubrication

Under no consideration should hard grease be used in either the transmission or rear axle, as after the car is driven a few miles a channel or path will be cut through by the gears and no further lubrication will be provided to working parts.

The transmission should be inspected for oil at least every 1,000 miles on all models. A grease of the consistency of steam cylinder oil should be used or a transmission oil which is sold by oil companies for that purpose. There should be sufficient oil in the transmission to allow the gears on the spline shaft to dip. This will permit the oil to be carried from one gear to another and all parts properly lubricated.

You will find on the left side of transmission case on Models Four-Ninety, Superior and G, and right side of transmission case on Models FA, FB and T, a level plug which indicates oil level and should be filled with oil to this point.

Rear Axle Lubrication

The rear axle should be filled with oil of the same consistency as used in transmission through the grease plug on the right hand side of differential housing, and be kept level with this point.

Wheel Bearings

The front wheel bearings on all models should be kept packed with cup grease and about every 600 miles (Fig. 49) the wheels should be removed and bearings washed in gasoline and packed with new grease.

The rear wheel bearings should be packed with grease, but do not need very much attention as a certain amount of lubrication will work through from the rear axle.

Chassis Parts

Most of the working parts underneath the car, which are exposed to the condition of the roads, are provided with grease cups with the exception of brake shafts, brake rod, yoke pins, etc., and they should be oiled with an oil which can be applied with a squirt can. You should advise your customers that this is important. (See Lubrication charts, Fig. 126 to 131).

The charts on lubrication show where and when to lubricate the different units of a Chevrolet car. The thing to bear uppermost in mind is that oil and grease are much cheaper than repair bills and a suggestion from the mechanic will oft times save the owner a great deal of expense and inconvenience; also enable him to receive the maximum of useful service from his car.

He should not wait to hear a "squeak" before oiling. A "squeak" means a rusted or dry bearing, and when once in that condition, trouble soon follows.

The compact construction of a Chevrolet makes necessary the placing of oil holes and grease cups under the floor boards of the car. Don't, because it might cause a little extra trouble, forget to remove them and lubricate as directed.

We guarantee that, when adjusted and lubricated, following the instructions contained in this book, the car or truck will give a maximum of service at a minimum of upkeep cost.

For those who wish, we have prepared an enlarged cut of the oiling charts which can be tacked on the garage wall for handy reference. Write us for these charts.

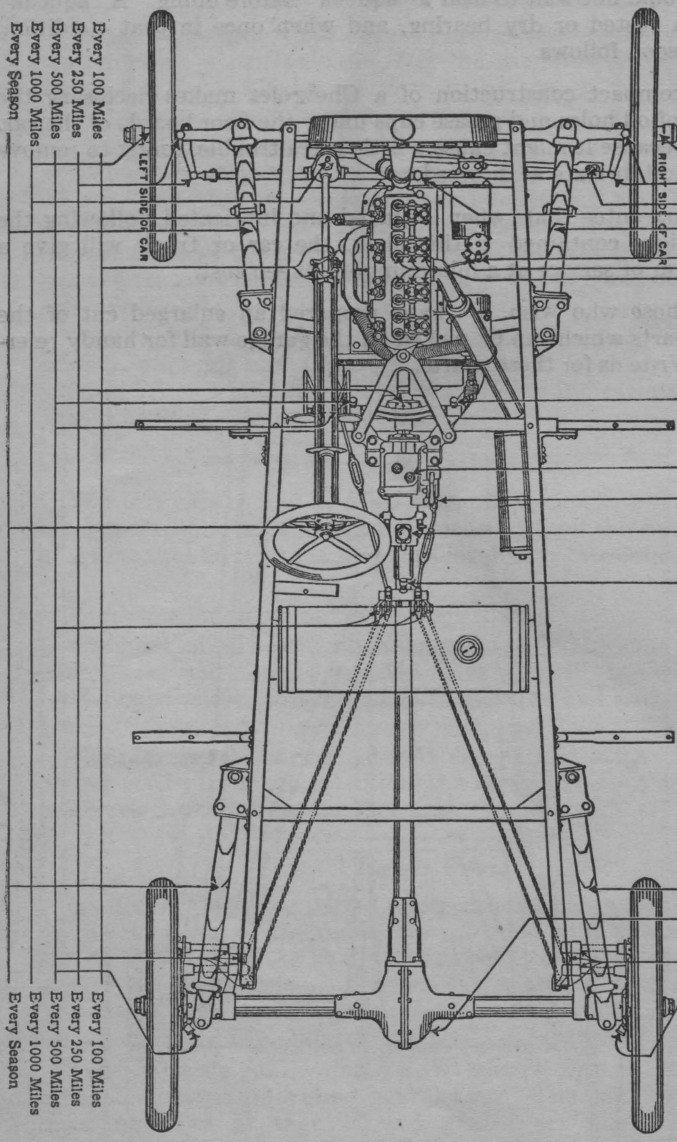

Fig. 126—Lubrication chart, Model Four-Ninety

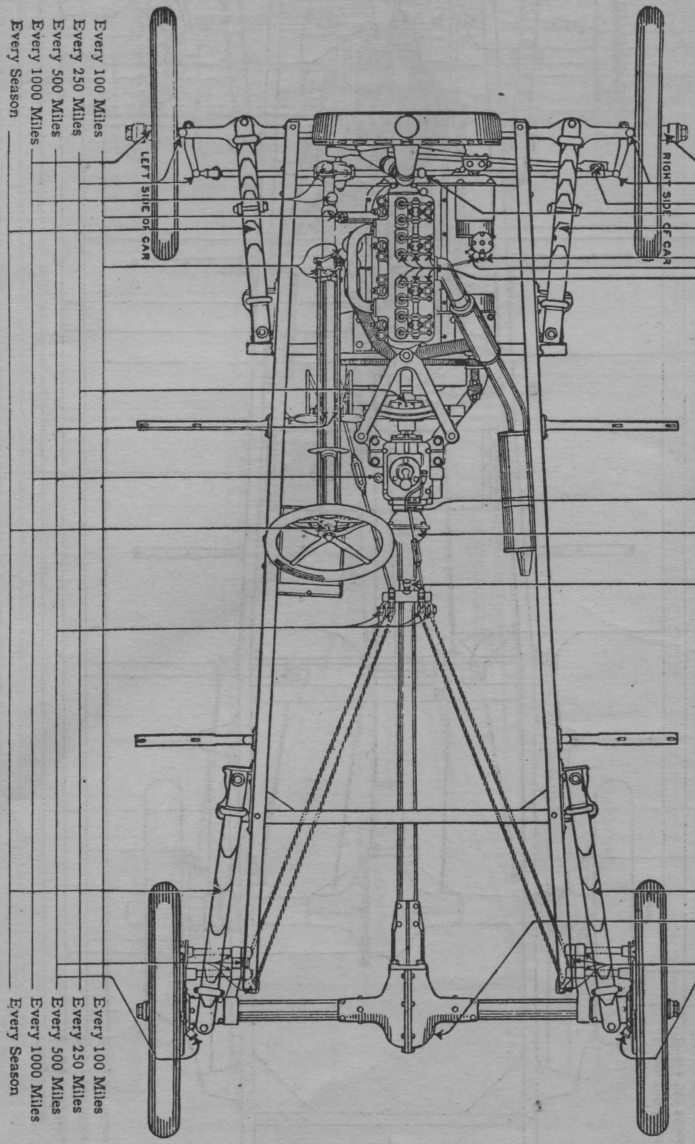

Fig. 127—Lubrication Chart, Superior Model

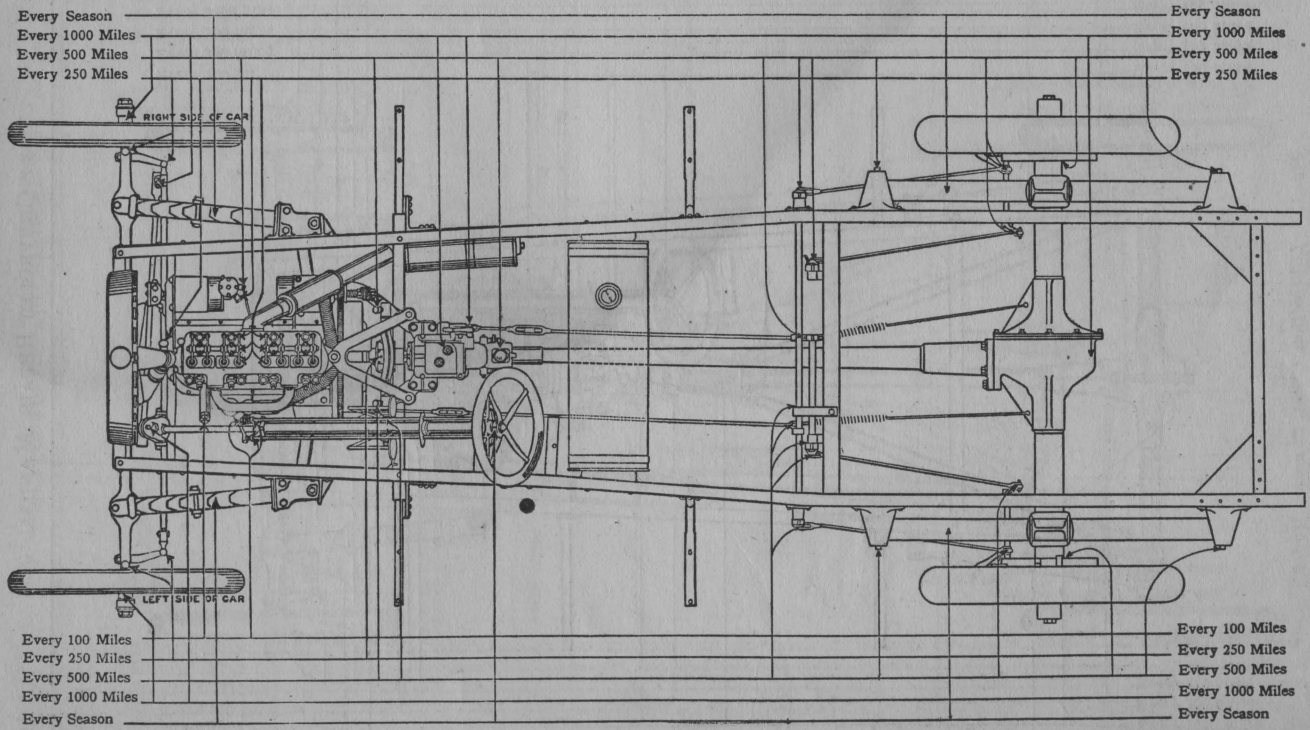

Fig 128—Lubricating Chart Model G

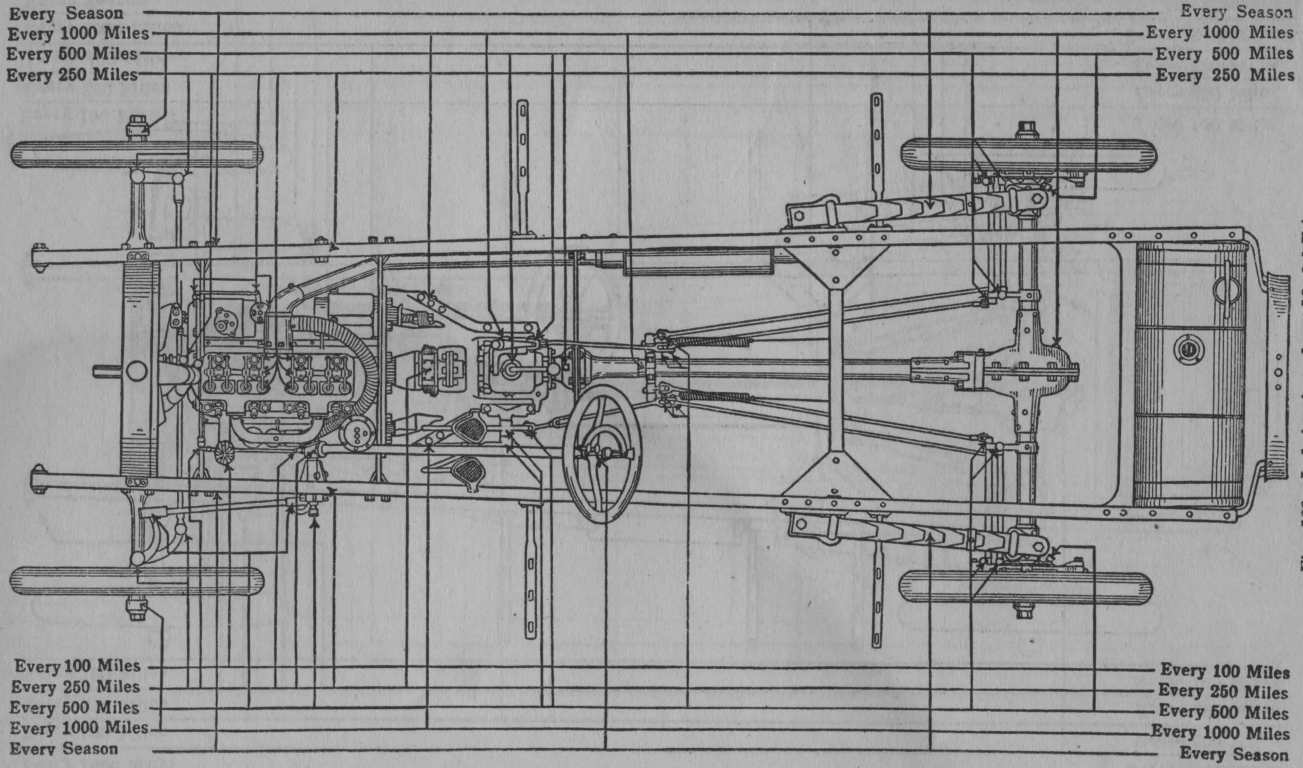

Fig. 129—Lubrication chart Model FA

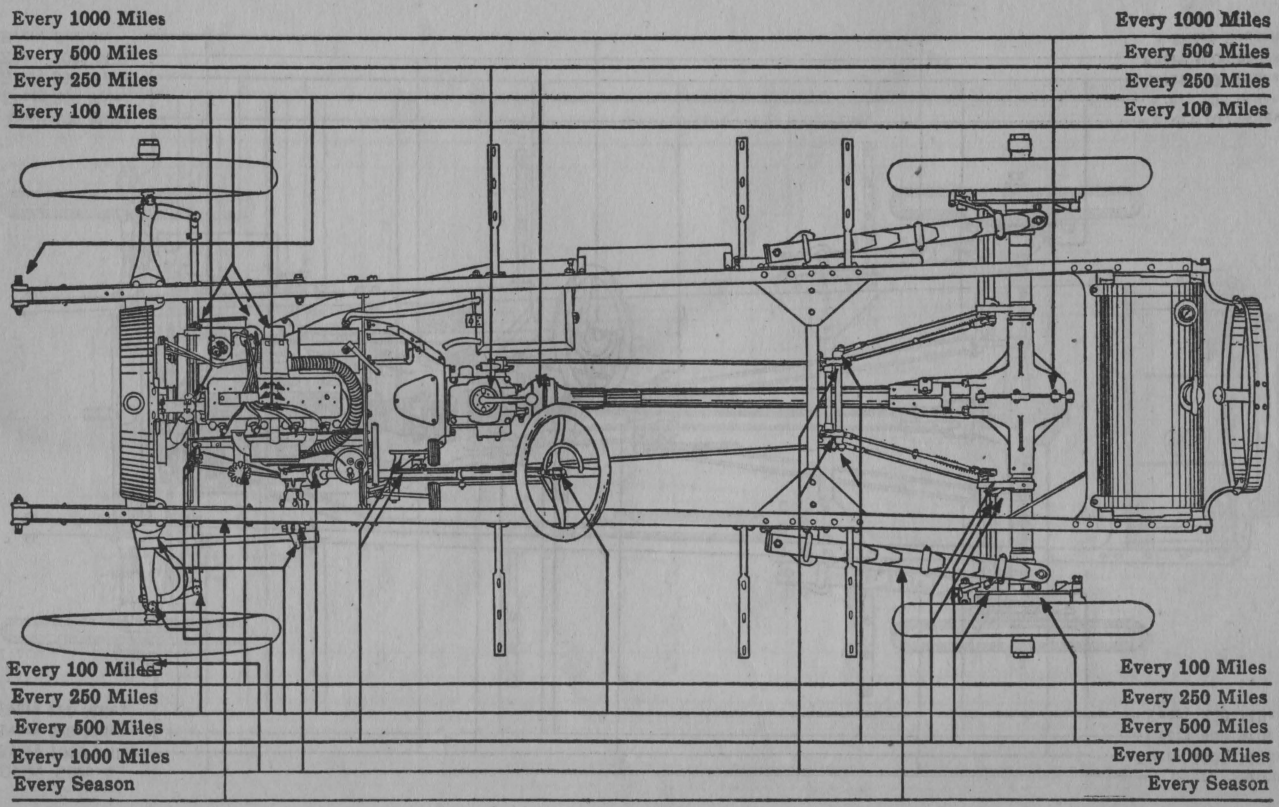

Fig. 130—Lubrication chart, Model FB

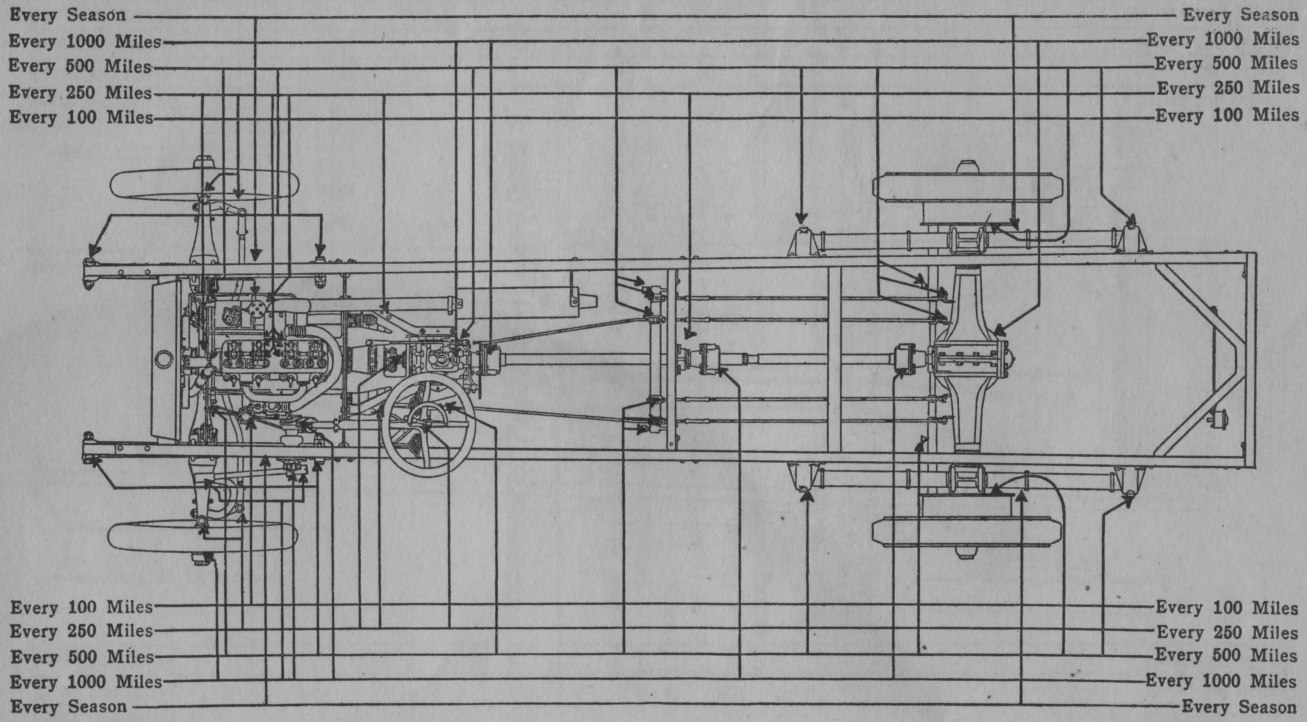

Fig. 131—Lubrication chart, Model T.

Chapter VI

Special Tool Equipment for Chevrolet Passenger Cars and Trucks

We have illustrated in this chapter a number of special tools which are adaptable for use in repairing Chevrolet passenger cars and trucks.

Some of these tools are so designed and dimensions are given so that they can be built in your own repair shop.

Write any Chevrolet Zone Office for name of manufacturer and prices.

In our service organization we have a corps of trained men who are making a special study of tool equipment and will, from time to time, bring out new tools which will be of assistance in the repair shop.

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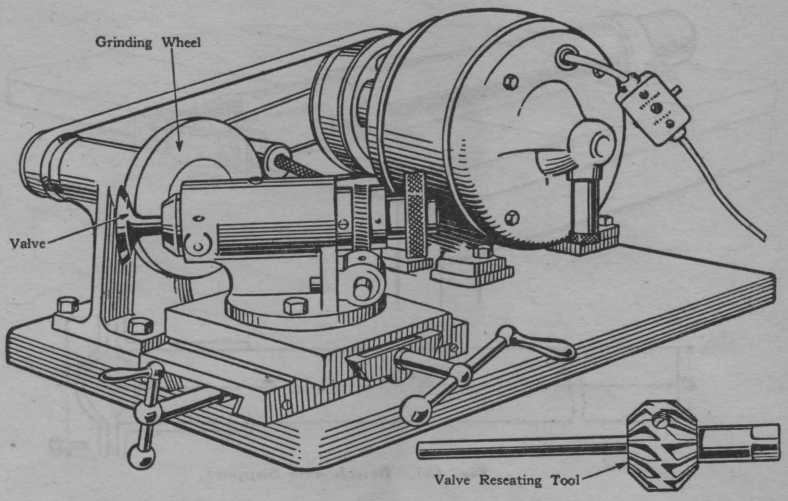


Fig. 132—Valve Grinding Tool

Fig. 133—Piston Pin Reamer

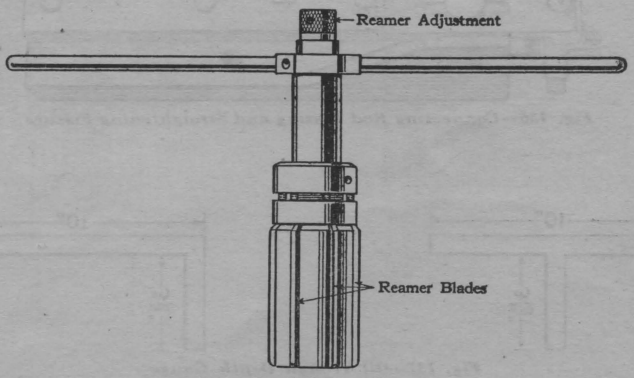


Fig. 134—Cylinder Reamer

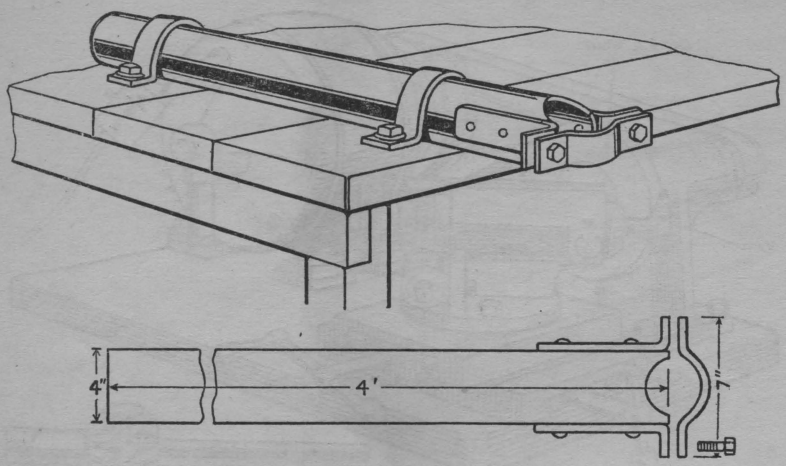


Fig. 135.—Bench Axle Support.

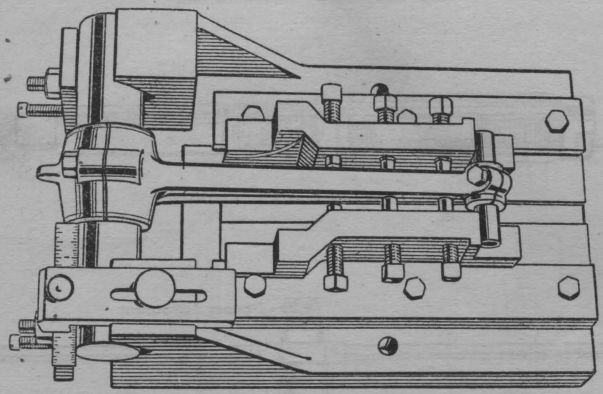


Fig. 136—Connecting Rod Testing and Straightening Fixture

Fig. 137—Oil Trough Depth Gauge

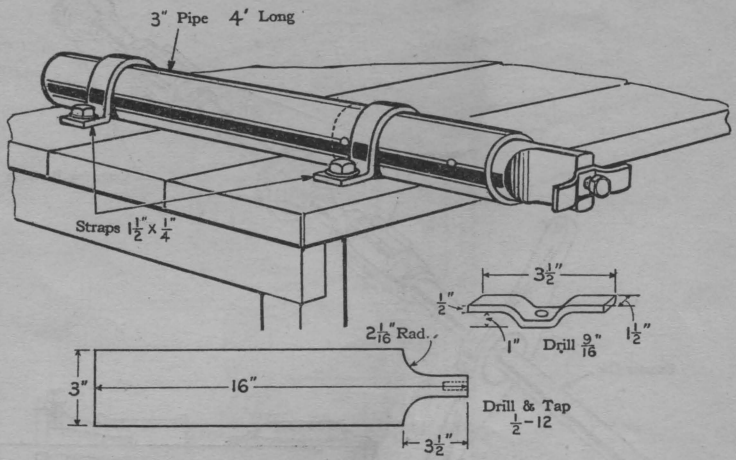


Fig. 138—Bench Moter Support

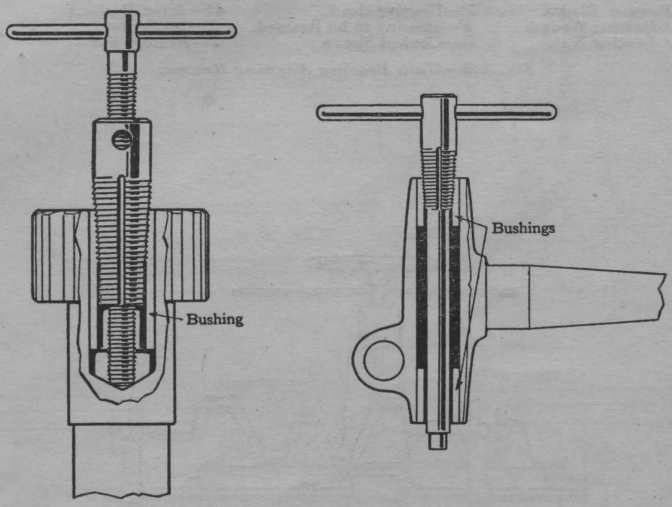
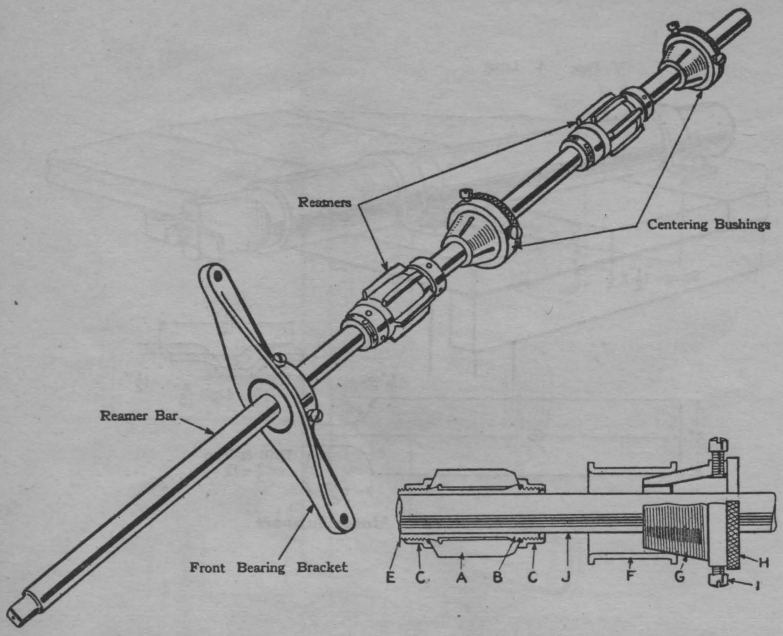


Fig. 139—Bushing Extractor



A—Reamer Blades.
B—Adjusting Wedges.
C—Adjusting Nut.
E—Reamer Head.
F—Bearing to be Reamed.
G—Conical Sleeve.
H—Inner Bushing.
I—Set Screw.
J—Reamer Bar

Fig. 140—Main Bearing Aligning Reamer

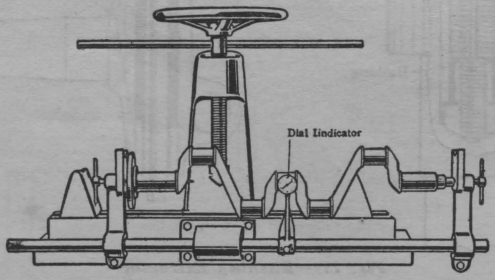


Fig. 141—Camshaft and Crankshaft straightening and Testing Press

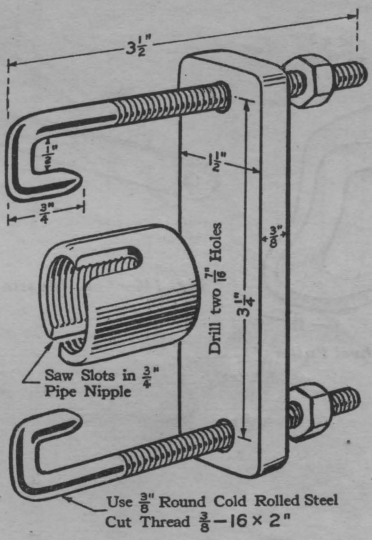


Fig. 142—Four-Ninety and Superior Clutch Puller

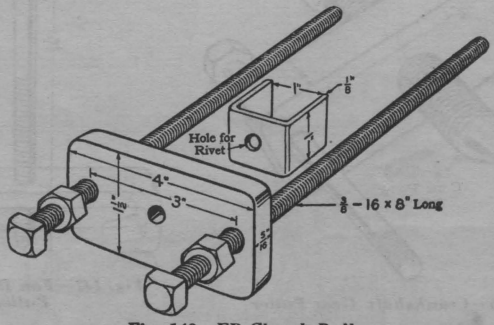


Fig. 143—FB Clutch Puller

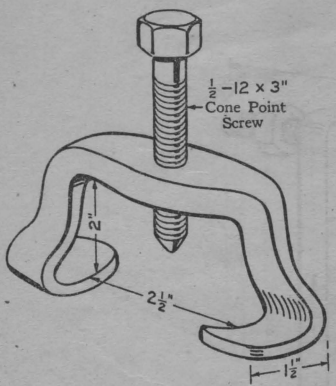


Fig. 144—Steering Wheel Puller

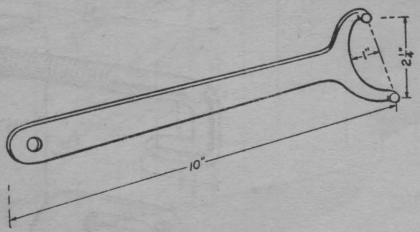


Fig. 145—Fan Adusting Spanner Wrench

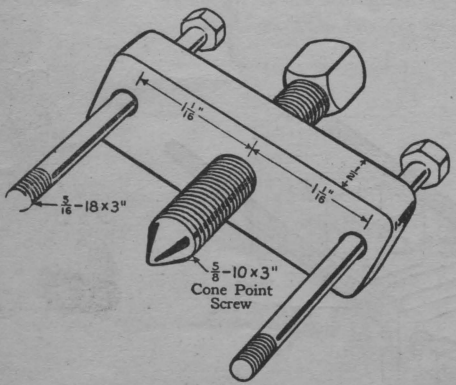


Fig. 146—Crankshaft Gear Puller

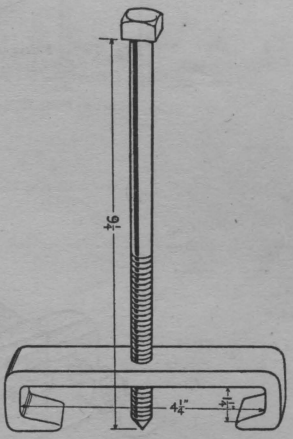


Fig. 147—Fan Drive Pulley Puller

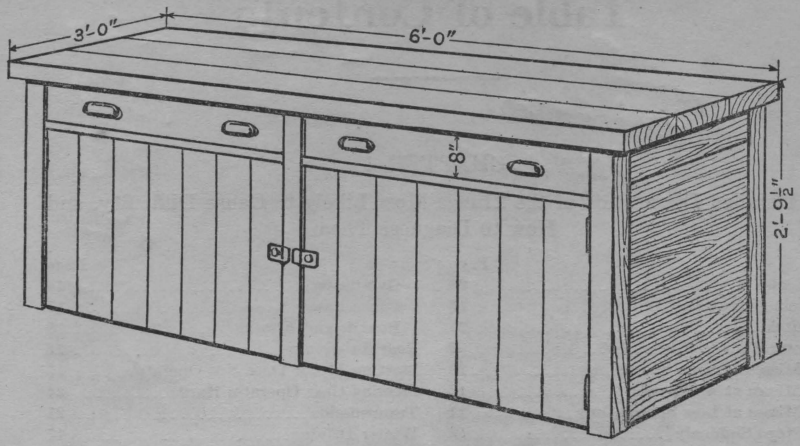


Fig. 148—Work Bench with storage space for assemblies

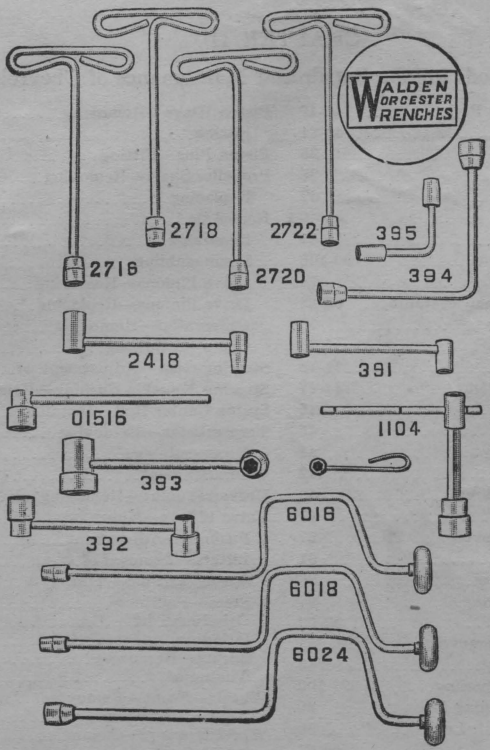


Fig. 149—Complete Set of "Walden" speed wrenches

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A Detailed Description of the Things Most Likely to Cause Difficulty, and How to Diagnose Them

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CHAPTER V

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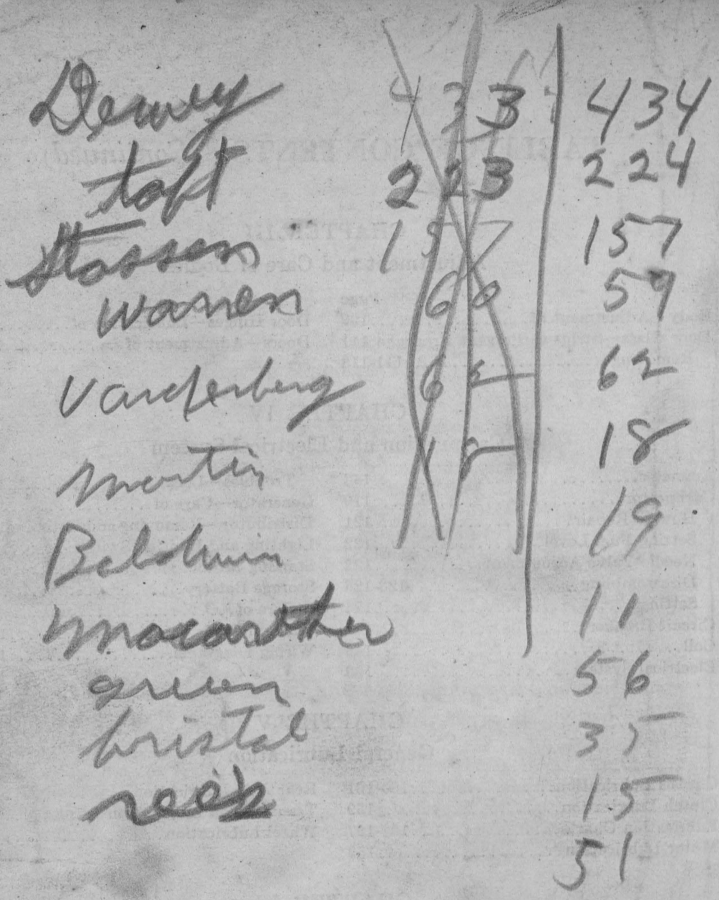
CHAPTER VI


Dewey
taft
Hoover
Warren
Vandenberg
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MacArthur
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